



JOHNSON CONTROLS, INC.  
812 First State Blvd  
Delmarva Branch N28  
Wilmington, DE 19804  
(302)996-0275

## Report of Eddy Current Inspection

Manufacturer: York

Model: OM3000

Serial: 626904 #7

Location: DUPONT EXPERIMENTAL STATION  
RT. 141 BETWEEN 52 & 202  
WILMINGTON, DE 19735

Inspected: March 1, 2016-March 3, 2016

Inspected By: DAVID H. AMENT, LEVEL III  
TAI Services, Inc.

Reviewed By:   
TECHNICAL MANAGER, LEVEL III

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Vessel Information

Manufacturer	Model	Style	Serial Number	Type
York	OM3000	Open Drive	626904 #7	Centrifugal

B/H Condenser	
TestEnd	Opposite Inlet/Outlet
Tube Count	1326
Tube Type	Skip Fin IE
Tube Material	Copper
OD	.750
*NWT/Under Fins	.028
*NWT/Bell/Land	.052
#/Type Support	5 Mild Steel
Tube Numbering	Left to Right
Row Numbering	Top to Bottom
Tube Length +- 2	216 Inches

Evaporator	
TestEnd	Inlet/Outlet End
Tube Count	1852
Tube Type	Skip Fin IE
Tube Material	Copper
OD	.750
*NWT/Under Fins	.028
*NWT/Bell/Land	.052
#/Type Support	5 Mild Steel
Tube Numbering	Left to Right
Row Numbering	Top to Bottom
Tube Length +- 2	216 Inches

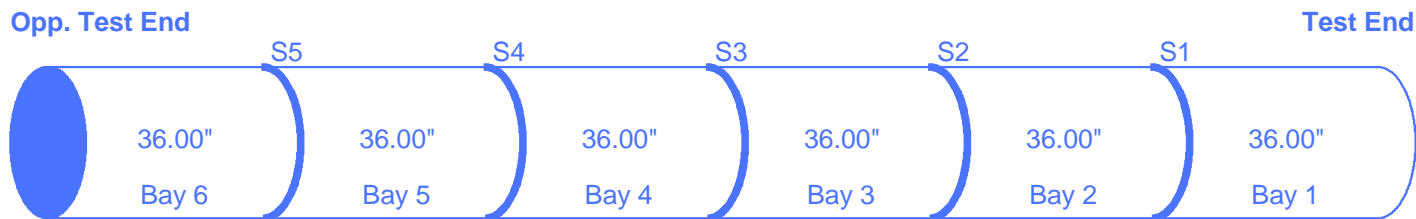
T/H Condenser	
TestEnd	Opposite Inlet/Outlet
Tube Count	1264
Tube Type	Skip Fin IE
Tube Material	Copper
OD	.750
*NWT/Under Fins	.028
*NWT/Bell/Land	.052
#/Type Support	5 Mild Steel
Tube Numbering	Left to Right
Row Numbering	Top to Bottom
Tube Length +- 2	216 Inches

Analyst: DAVID H. AMENT, LEVEL III

\* Nominal Wall Thickness

### Vessel Bay Length Information

#### B/H Condenser (Length = 216 inches) S = Intermediate Support



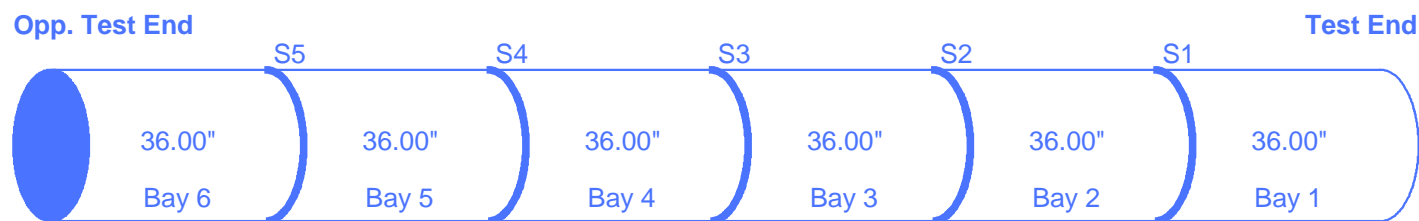
Bay 6	36.00"
Bay 5	36.00"
Bay 4	36.00"
Bay 3	36.00"
Bay 2	36.00"
Bay 1	36.00"

#### Evaporator (Length = 216 inches) S = Intermediate Support



Bay 6	36.00"
Bay 5	36.00"
Bay 4	36.00"
Bay 3	36.00"
Bay 2	36.00"
Bay 1	36.00"

**T/H Condenser (Length = 216 inches)  
S = Intermediate Support**



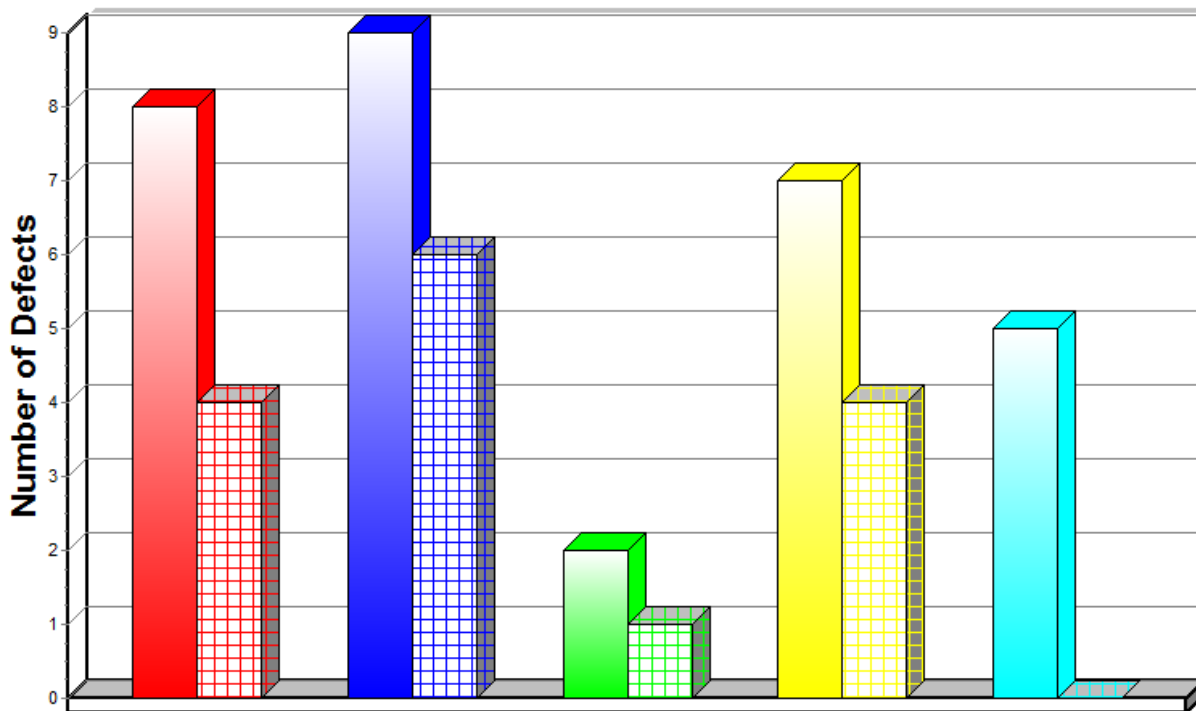
Bay 6	36.00"
Bay 5	36.00"
Bay 4	36.00"
Bay 3	36.00"
Bay 2	36.00"
Bay 1	36.00"

## Defect Summary/Comparison

Comparison of Tests Performed

3/2/2016 12/22/2010

### B/H Condenser Defects

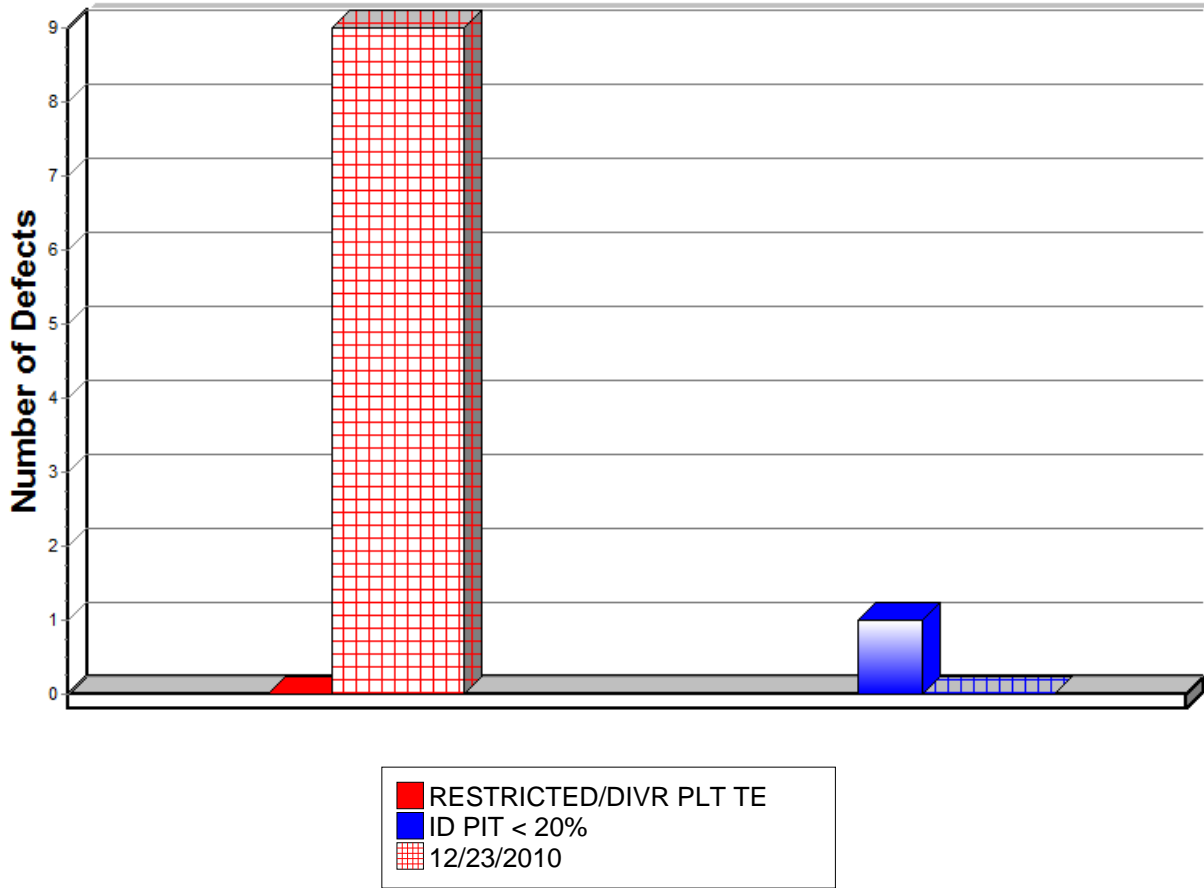


- ID CORROSION < 20%
- ID CORROSION 20% - 39%
- ID PIT < 20%
- ID PIT 20% - 39%
- TESTED, DEBRIS
- 12/22/2010

Location	Model	Serial Number
DUPONT EXPERIMENTAL STATION	OM3000	626904 #7

Note: The Graph will indicate a Comparison Analysis when the unit has been previously tested by TAI Services.

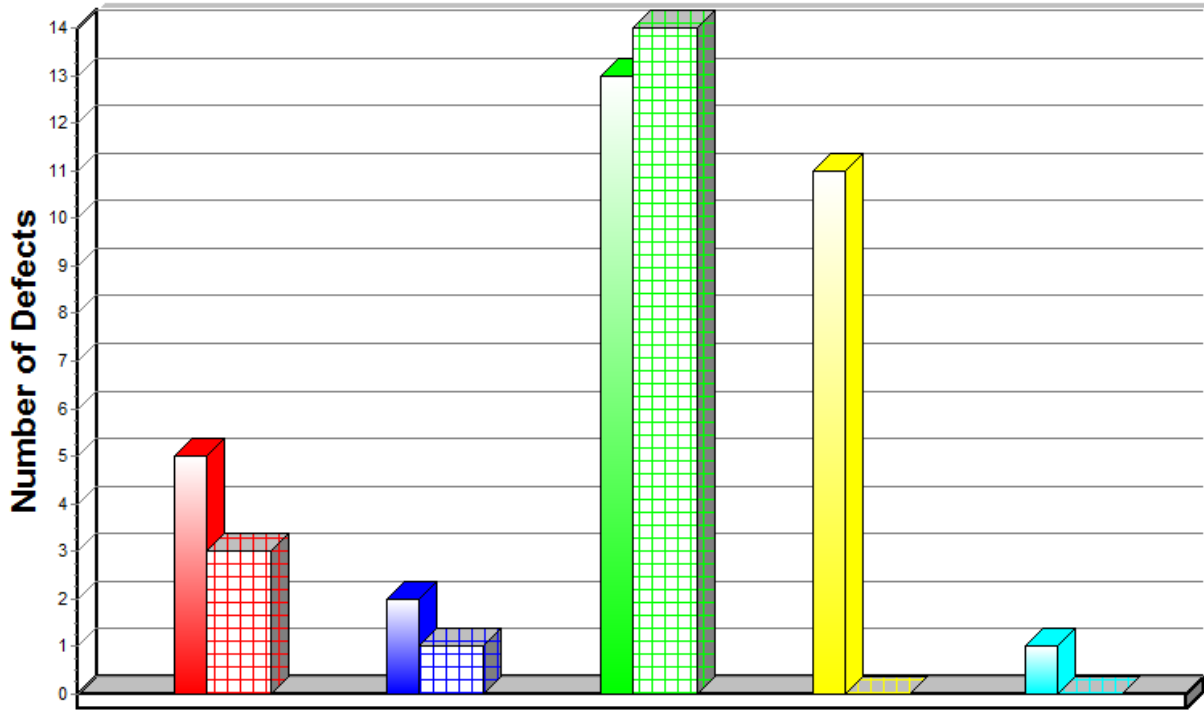
### Evaporator Defects



Location	Model	Serial Number
DUPONT EXPERIMENTAL STATION	OM3000	626904 #7

Note: The Graph will indicate a Comparison Analysis when the unit has been previously tested by TAI Services.

### T/H Condenser Defects



- ID CORROSION < 20%
- ID PIT < 20%
- ID PIT 20% - 39%
- TESTED, DEBRIS
- TESTED, NO DEFECTS
- 12/23/2010

Location	Model	Serial Number
DUPONT EXPERIMENTAL STATION	OM3000	626904 #7

Note: The Graph will indicate a Comparison Analysis when the unit has been previously tested by TAI Services.

## Summary of Inspection

An eddy current tube inspection was performed as part of a preventive maintenance program with the following results.

T/H Condenser: 1264 Tubes		
Significant/Measurable Indications	Number of Tubes Marked	Percent of Bundle
ID CORROSION < 20%	5	.40
ID PIT < 20%	2	.16
ID PIT 20% - 39%	13	1.03
TESTED, DEBRIS	11	.87
TESTED, NO DEFECTS	1	.08
<b>Totals</b>	<b>32</b>	<b>2.54</b>

B/H Condenser: 1326 Tubes		
Significant/Measurable Indications	Number of Tubes Marked	Percent of Bundle
ID CORROSION < 20%	8	.60
ID CORROSION 20% - 39%	9	.68
ID PIT < 20%	2	.15
ID PIT 20% - 39%	7	.53
TESTED, DEBRIS	5	.38
<b>Totals</b>	<b>31</b>	<b>2.34</b>

Evaporator: 1852 Tubes		
Significant/Measurable Indications	Number of Tubes Marked	Percent of Bundle
ID PIT < 20%	1	.05

## Summary of Inspection - Page 2

Evaporator: 1852 Tubes		
Significant/Measurable Indications	Number of Tubes Marked	Percent of Bundle
<b>Totals</b>	<b>1</b>	<b>.05</b>

## Recommendations

An eddy current inspection was performed on the tubes in this machine. This test was performed using accepted eddy current test methods for the inspection of in-service tubing. It should be noted that Eddy Current is not a leak detection method. The possibility does exist that tubes could contain defects and/or leaks which are not detectable. If leaks are suspected, we recommend a pressure test be used to identify the leaking tubes.

The following suggested repair actions are based on accepted industry standards. After removing sample tubes to confirm the inspection results, a determination of corrective action should be made by the repair agency and end user. Only these parties have knowledge of the critical applications and long-term use of the equipment. If plugging is selected over replacement, both efficiency and capacity should be considered.

### CONDENSER:

The ID Corrosion detected appears minor and requires no corrective action at this time. ID Corrosion is the deterioration of the tube's inner surface due to a biological or chemical attack and is usually progressive.

The ID Pits marked require no immediate corrective action. However, this type damage is usually progressive and should be monitored.

The tubes marked as Tested Debris require no corrective action at this time. These tubes contain ID deposits and/or foreign material. No damage was detected and no corrective action is required at this time.

The damage indications marked during the previous inspection were not detectable during this inspection. The indications are believed to have been caused by debris not other conditions which are now not present.

(NOTE: For both bundles a smaller .500 probe was used due to debris (epoxy possibly) being in the tubes. The .5625 probe worked in some tubes, switched to the smaller probe after the restrictions became too frequent.)

### EVAPORATOR:

The ID Pits marked require no immediate corrective action. However, this type damage is usually progressive and should be monitored.

### RE-INSPECTION RECOMMENDATIONS:

We recommend that a follow-up inspection be performed on these vessels as follows:

T/H Condenser: 01 March 2019

B/H Condenser: 02 March 2019

Evaporator: 03 March 2019

A copy of this report should be retained in your files to be used for comparison at that time.

If you should have any questions concerning this report, or if we may be of further assistance, please feel free to call upon us.

Data Sheet

Location	Model	Serial Number	Date
DUPONT EXPERIMENTAL STATION	OM3000	626904 #7	March 1, 2016
RT. 141 BETWEEN 52 & 202			
WILMINGTON, DE 19735			

Row	Tube	Description	Area	Action Req.
<b>SET UP CALIBRATE &amp; STARTED</b>				
T/H CONDENSER 3/2/2016 08:57 am				
<b>CALIBRATION CHECK 3/2/2016 08:49 am</b>				
5	3	ID CORROSION < 20%	B03	
10	14	TESTED, DEBRIS	All	
11	26	TESTED, NO DEFECTS	B02	
12	20	TESTED, DEBRIS	All	
12	21	ID PIT < 20%	B03	
13	23	TESTED, DEBRIS	All	
16	22	ID CORROSION < 20%	B02	
19	31	ID PIT 20% - 39%	B01	
20	11	TESTED, DEBRIS	All	
20	12	TESTED, DEBRIS	All	
20	21	TESTED, DEBRIS	All	
20	45	ID PIT 20% - 39%	B03	
21	24	TESTED, DEBRIS	All	
22	37	TESTED, DEBRIS	B08	
22	40	TESTED, DEBRIS	B08	
22	42	TESTED, DEBRIS	B08	
22	43	ID PIT 20% - 39%	B04	
24	11	ID CORROSION < 20%	B05	

Row	Tube	Description	Area	Action Req.
24	12	ID CORROSION < 20%	B01	
24	30	ID PIT 20% - 39%	B01	
24	31	ID PIT 20% - 39%	B01	
24	33	ID PIT 20% - 39%	B04	
26	44	ID PIT 20% - 39%	B06	
26	46	ID PIT 20% - 39%	B01	
27	9	ID PIT 20% - 39%	B01	
27	54	ID PIT 20% - 39%	B01	
28	7	ID CORROSION < 20%	B06	
28	28	ID PIT < 20%	B01	
29	50	ID PIT 20% - 39%	B06	
32	16	ID PIT 20% - 39%	B03	
26	34	ID PIT 20% - 39%	B06	
28	37	TESTED, DEBRIS	All	
<b>CALIBRATION CHECK &amp; COMPLETED</b>				
T/H CONDENSER 3/2/2016 10:23 am				
<b>SET UP CALIBRATE &amp; STARTED</b>				
B/H CONDENSER 3/3/2016 08:24 am				
1	28	TESTED, DEBRIS	All	
1	48	ID CORROSION 20% - 39%	B05	
2	12	ID PIT < 20%	B04	
2	34	ID PIT 20% - 39%	B01	
2	41	TESTED, DEBRIS	All	
3	1	TESTED, DEBRIS	All	
3	7	ID PIT 20% - 39%	B06	
3	43	TESTED, DEBRIS	All	

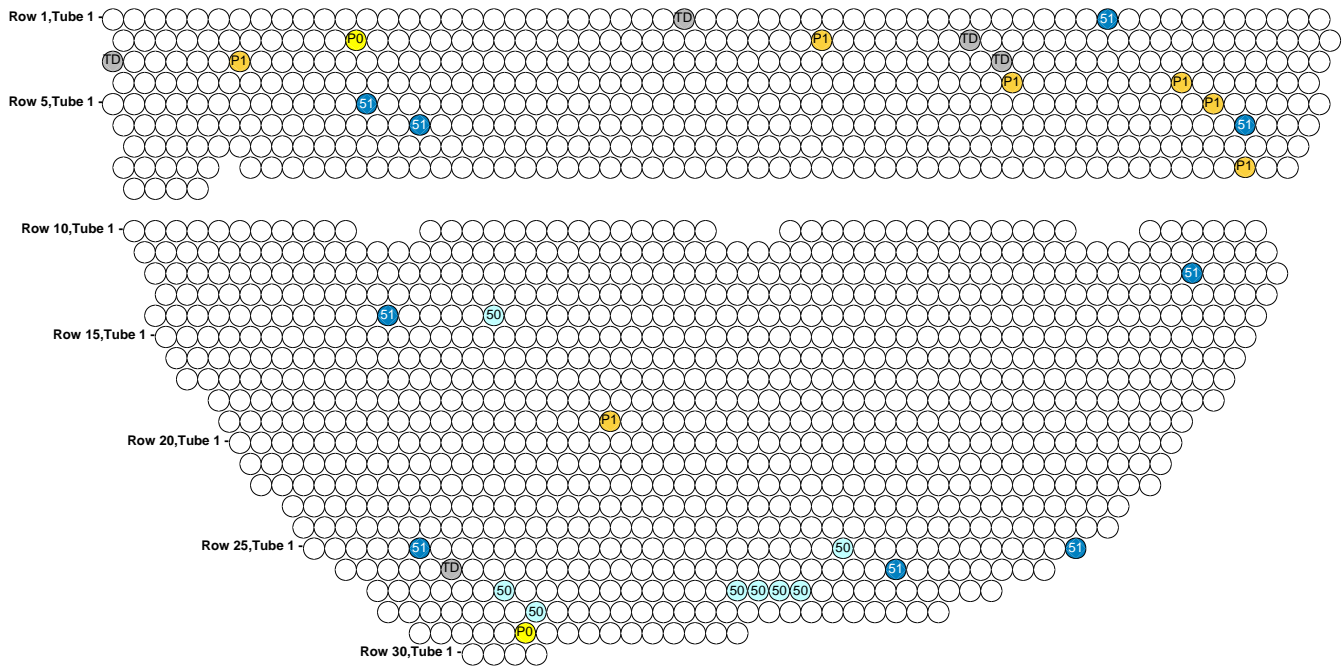
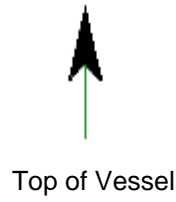
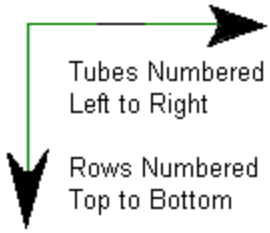
Row	Tube	Description	Area	Action Req.
4	43	ID PIT 20% - 39%	B03	
4	51	ID PIT 20% - 39%	B06	
5	13	ID CORROSION 20% - 39%	B06	
5	53	ID PIT 20% - 39%	B05	
6	15	ID CORROSION 20% - 39%	B06	
6	54	ID CORROSION 20% - 39%	B02	
8	53	ID PIT 20% - 39%	B05	
12	50	ID CORROSION 20% - 39%	B06	
14	12	ID CORROSION 20% - 39%	B06	
14	17	ID CORROSION < 20%	B05	
19	19	ID PIT 20% - 39%	B06	
25	6	ID CORROSION 20% - 39%	B06	
25	26	ID CORROSION < 20%	B06	
26	6	TESTED, DEBRIS	All	
27	7	ID CORROSION < 20%	B05	
27	18	ID CORROSION < 20%	B06	
27	19	ID CORROSION < 20%	B06	
27	20	ID CORROSION < 20%	B06	
27	21	ID CORROSION < 20%	B06	
28	8	ID CORROSION < 20%	B05	
29	6	ID PIT < 20%	B06	
26	27	ID CORROSION 20% - 39%	B06	
25	37	ID CORROSION 20% - 39%	B06	
<b>CALIBRATION CHECK &amp; COMPLETED</b>				
B/H CONDENSER 3/3/2016 09:36 am				
<b>SET UP CALIBRATE &amp; STARTED</b>				

Row	Tube	Description	Area	Action Req.
EVAPORATOR 3/4/2016 08:42 am				
22	32	ID PIT < 20%	B02	
<b><i>CALIBRATION CHECK &amp; COMPLETED</i></b>				
EVAPORATOR 3/4/2016 01:28 pm				

# B/H Condenser Section

S/N 626904 #7

Opposite Inlet/Outlet

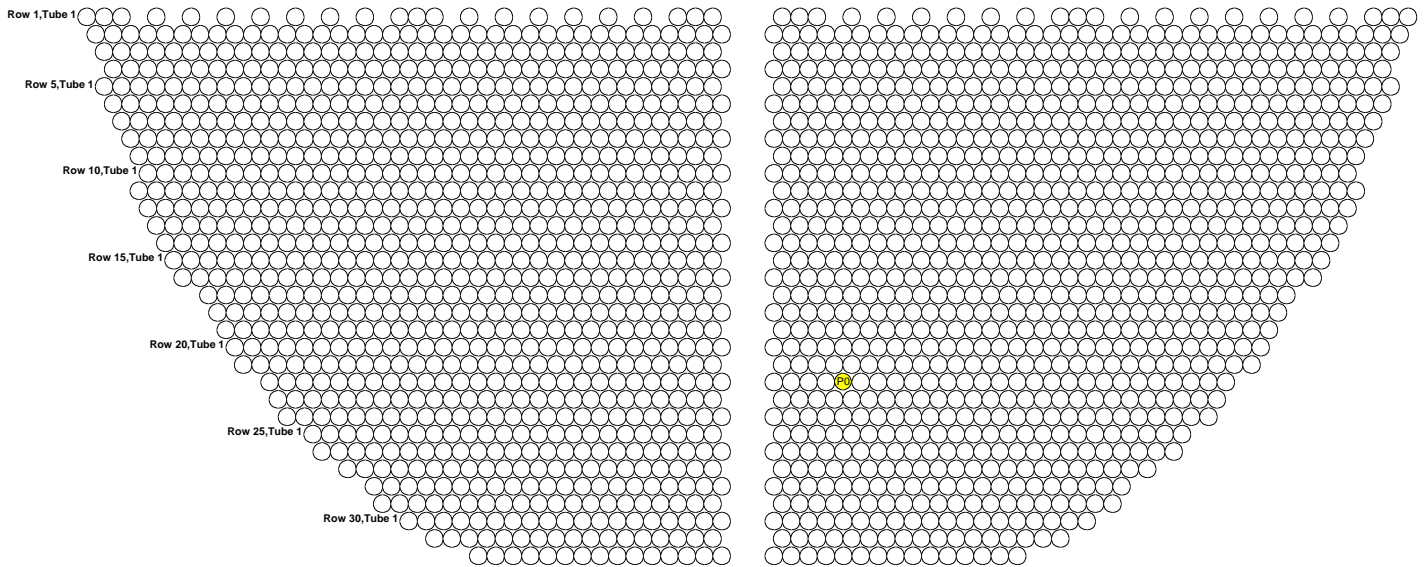
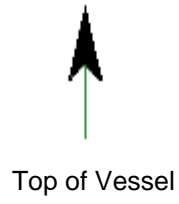
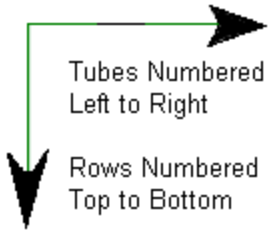


- ⑤① = ID CORROSION < 20%
- ⑤② = ID CORROSION 20% - 39%
- ④① = ID PIT < 20%
- ④② = ID PIT 20% - 39%
- ③① = TESTED, DEBRIS

# Evaporator Section

S/N 626904 #7

Inlet/Outlet End

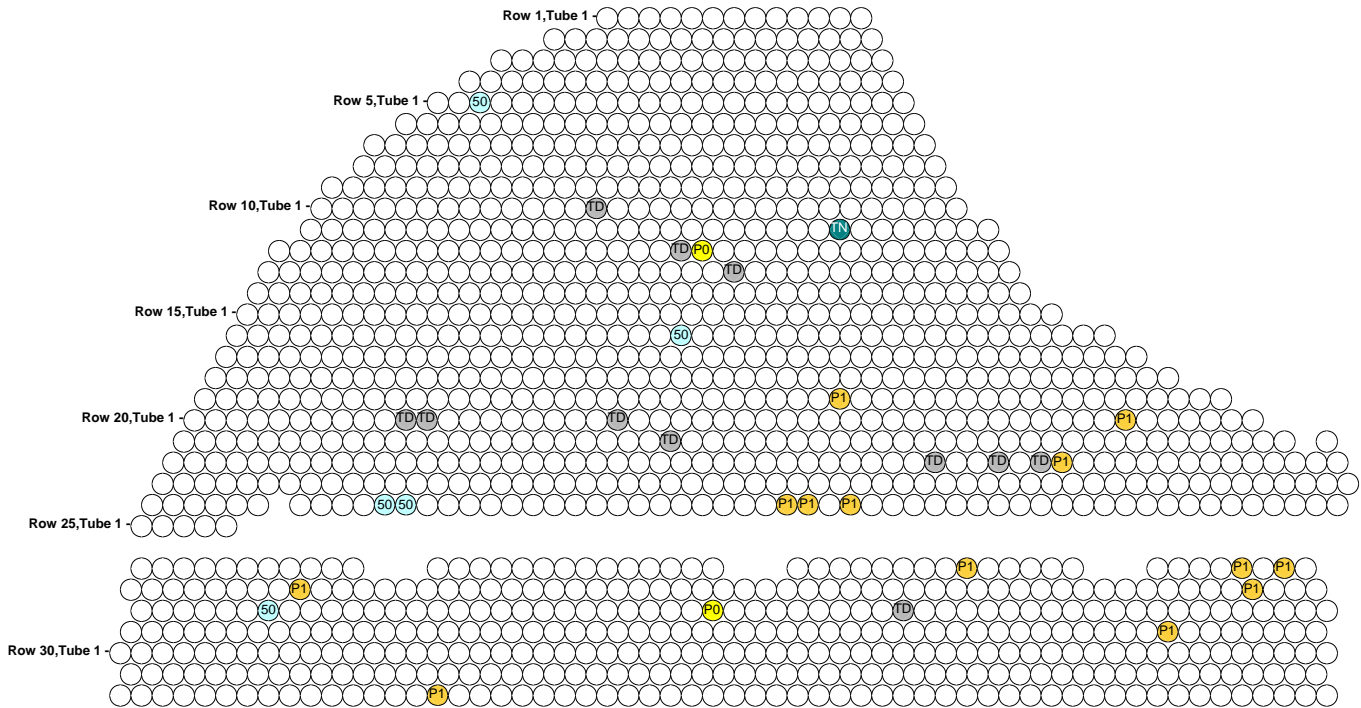
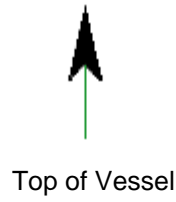
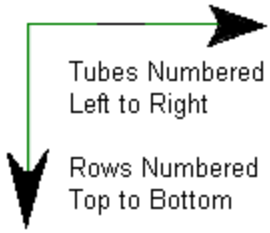


 = ID PIT < 20%

# T/H Condenser Section

S/N 626904 #7

Opposite Inlet/Outlet



50 = ID CORROSION < 20%

P0 = ID PIT < 20%

P1 = ID PIT 20% - 39%

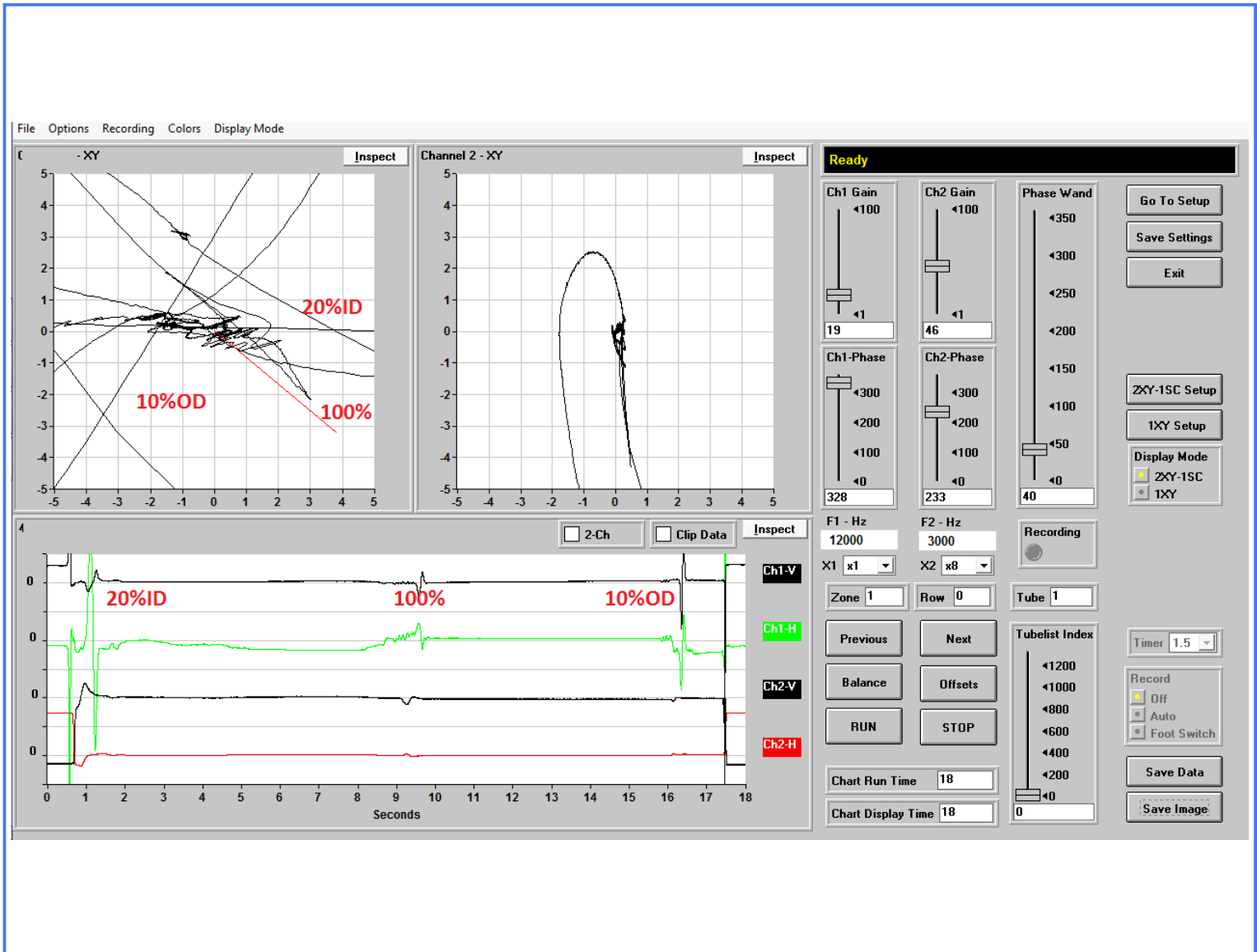
TD = TESTED, DEBRIS

TN = TESTED, NO DEFECTS

## Calibration Page

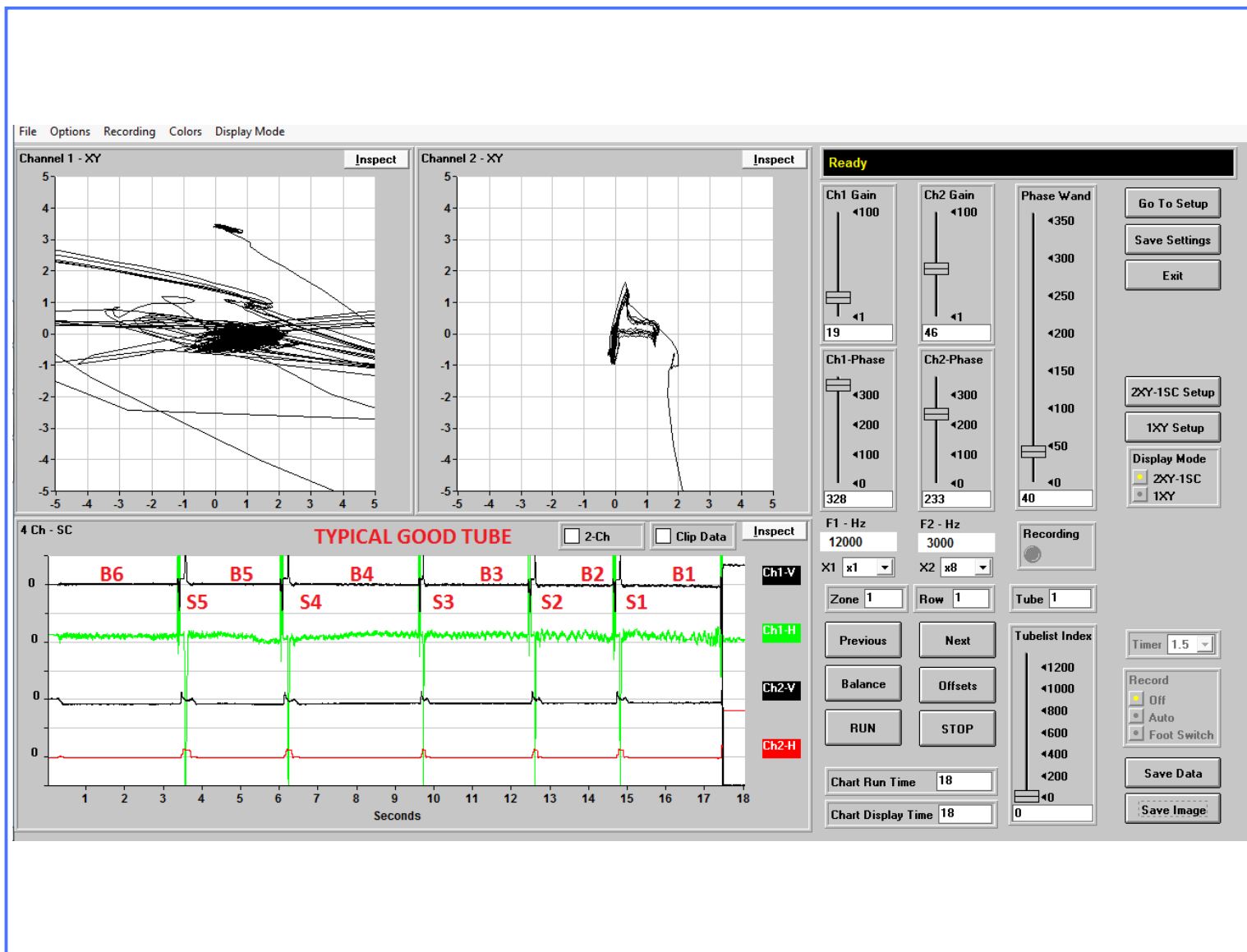
Tube Type	Material	Nom Wall Thick	End Wall Thick	OD	Test Type	Probe Diameter
Skip Fin IE	Copper	.028	.052	.750	CROSS/DIFF	.500

B/H Condenser



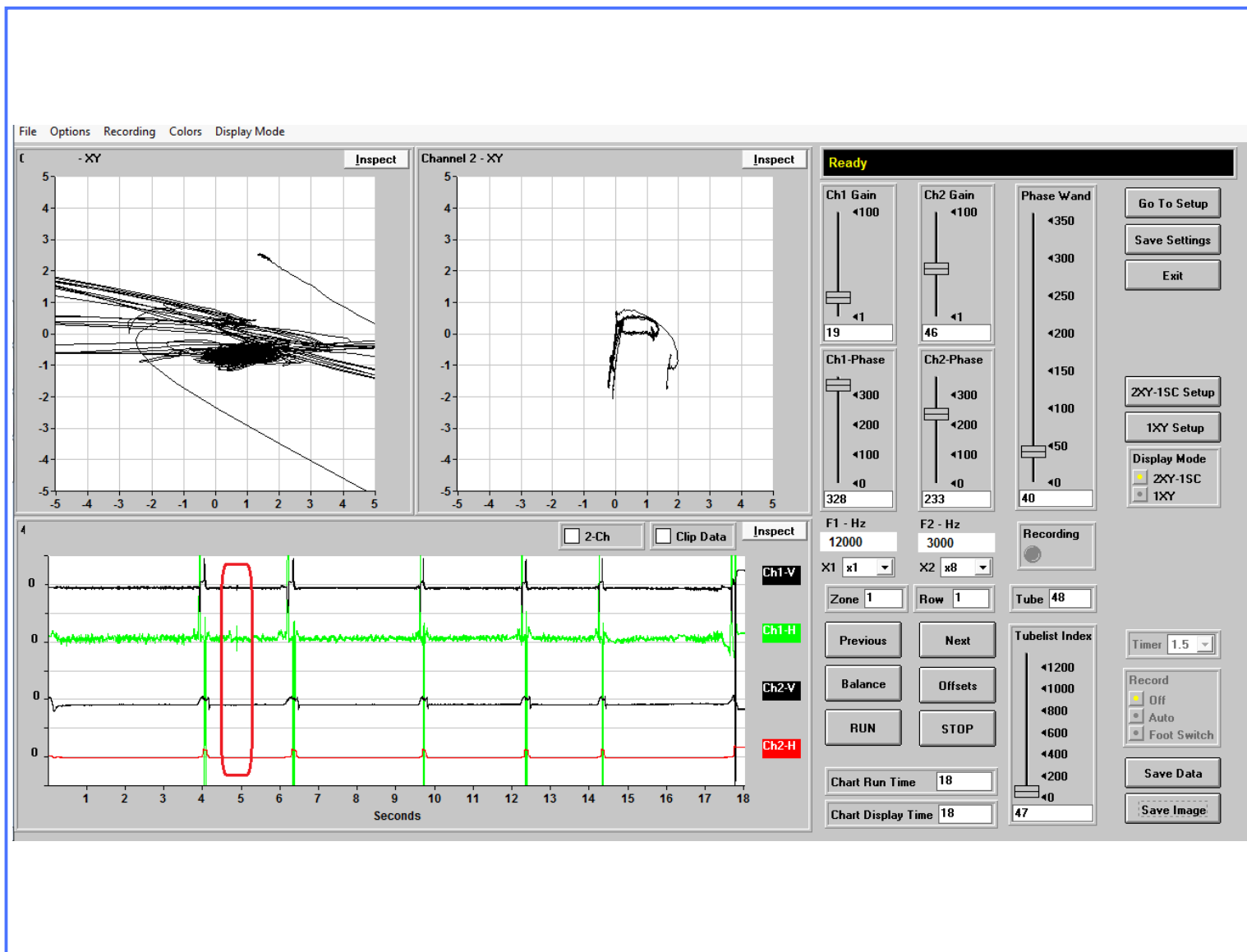
Note: Defects are compared to machined standards.  
Actual Defect Geometry may differ.

# B/H Condenser Section



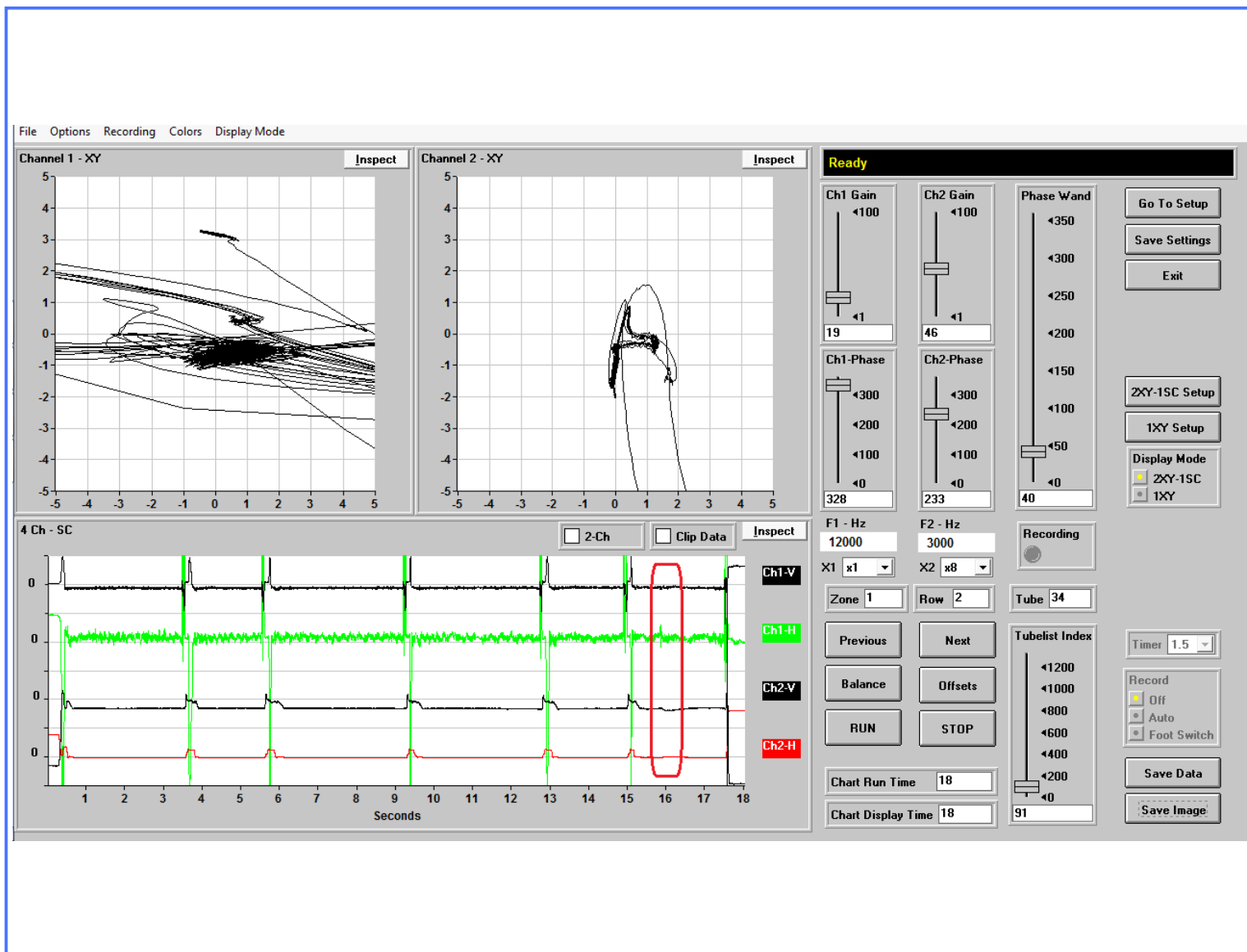
NO SIGNIFICANT DEFECTS (Row 1 Tube 1)

# B/H Condenser Section



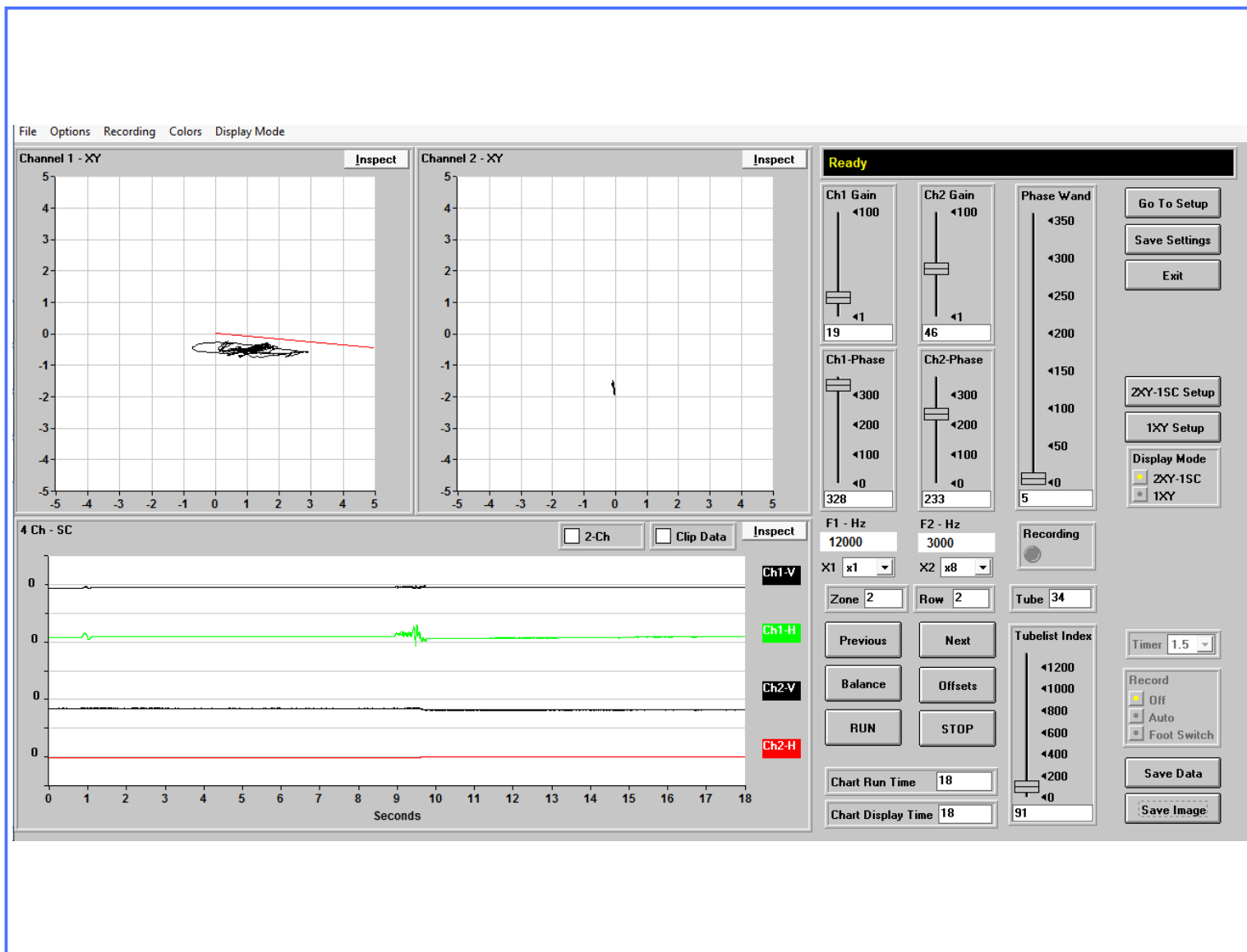
ID CORROSION 20% - 39% (Row 1 Tube 48)

# B/H Condenser Section



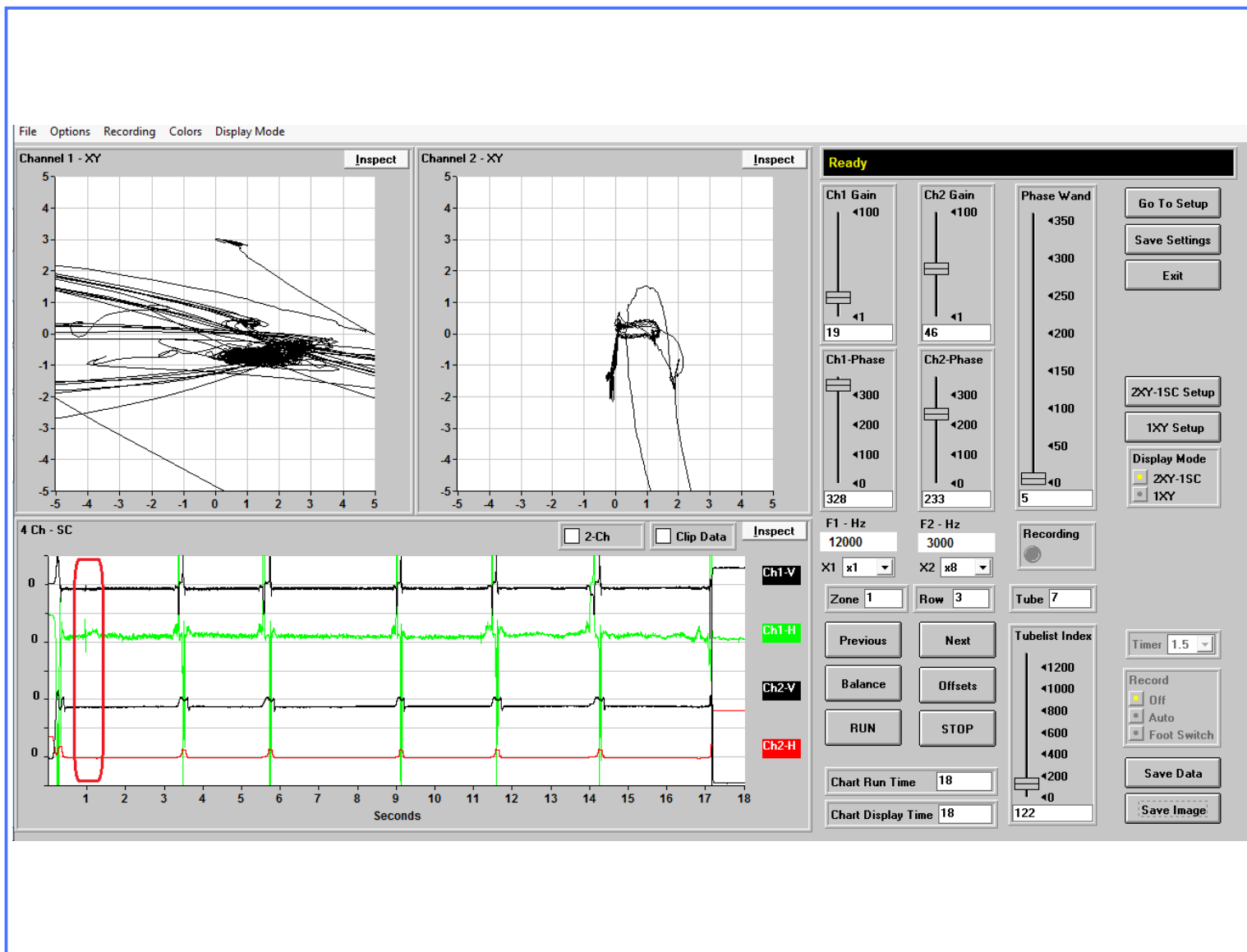
ID PIT 20% - 39% (Row 2 Tube 34)

# B/H Condenser Section



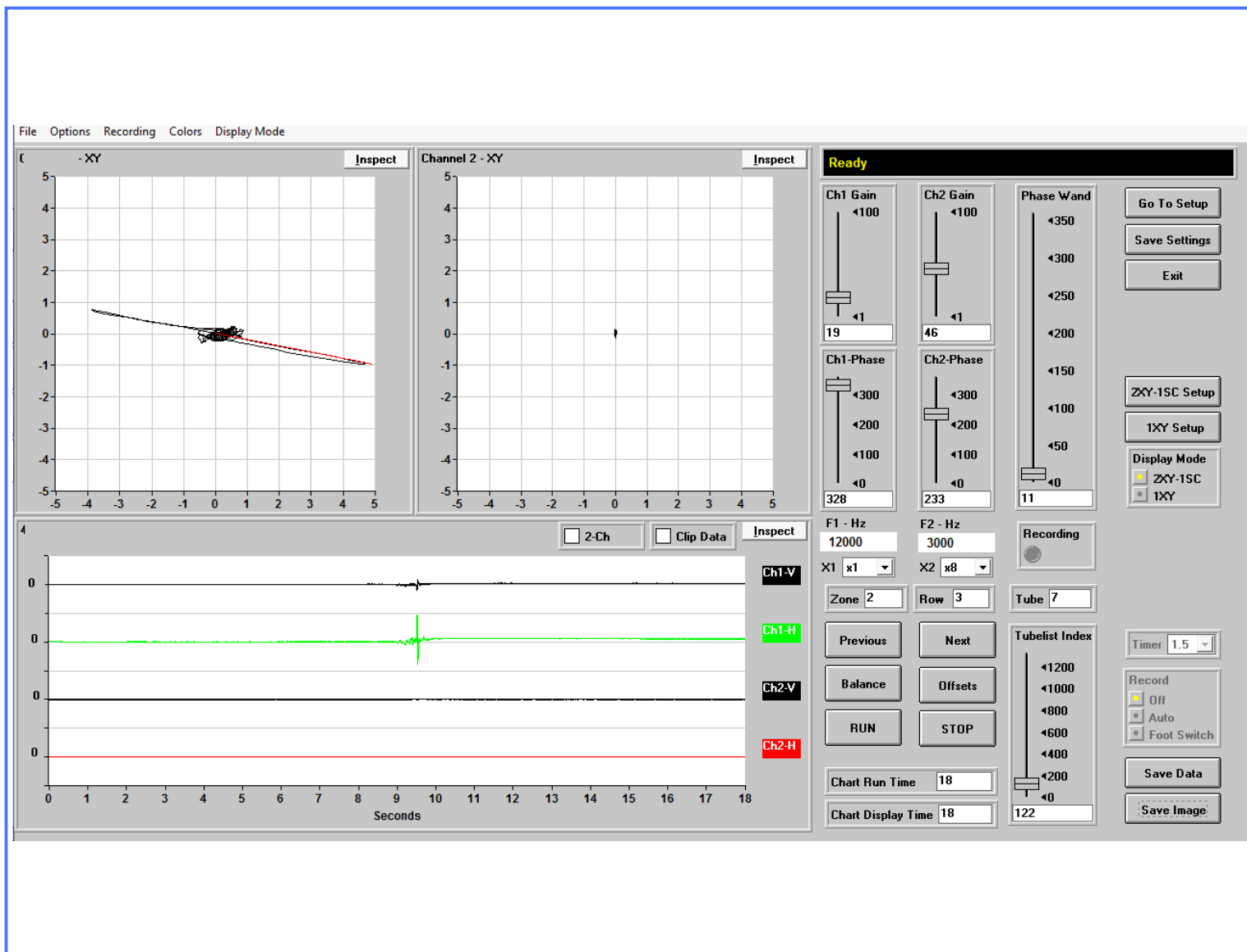
ID PIT 20% - 39% (Row 2 Tube 34)

# B/H Condenser Section



ID PIT 20% - 39% (Row 3 Tube 7)

# B/H Condenser Section

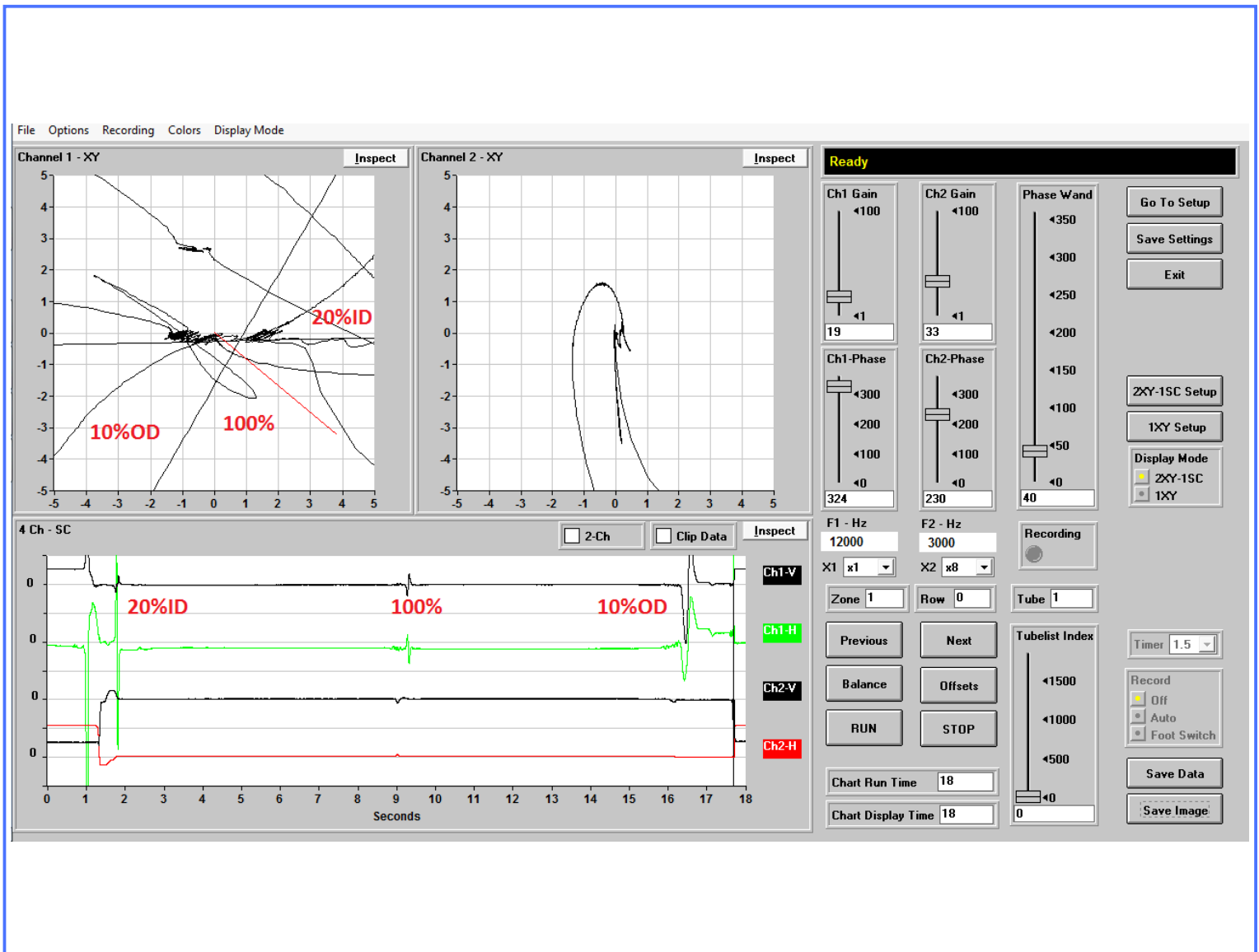


ID PIT 20% - 39% (Row 3 Tube 7)

## Calibration Page

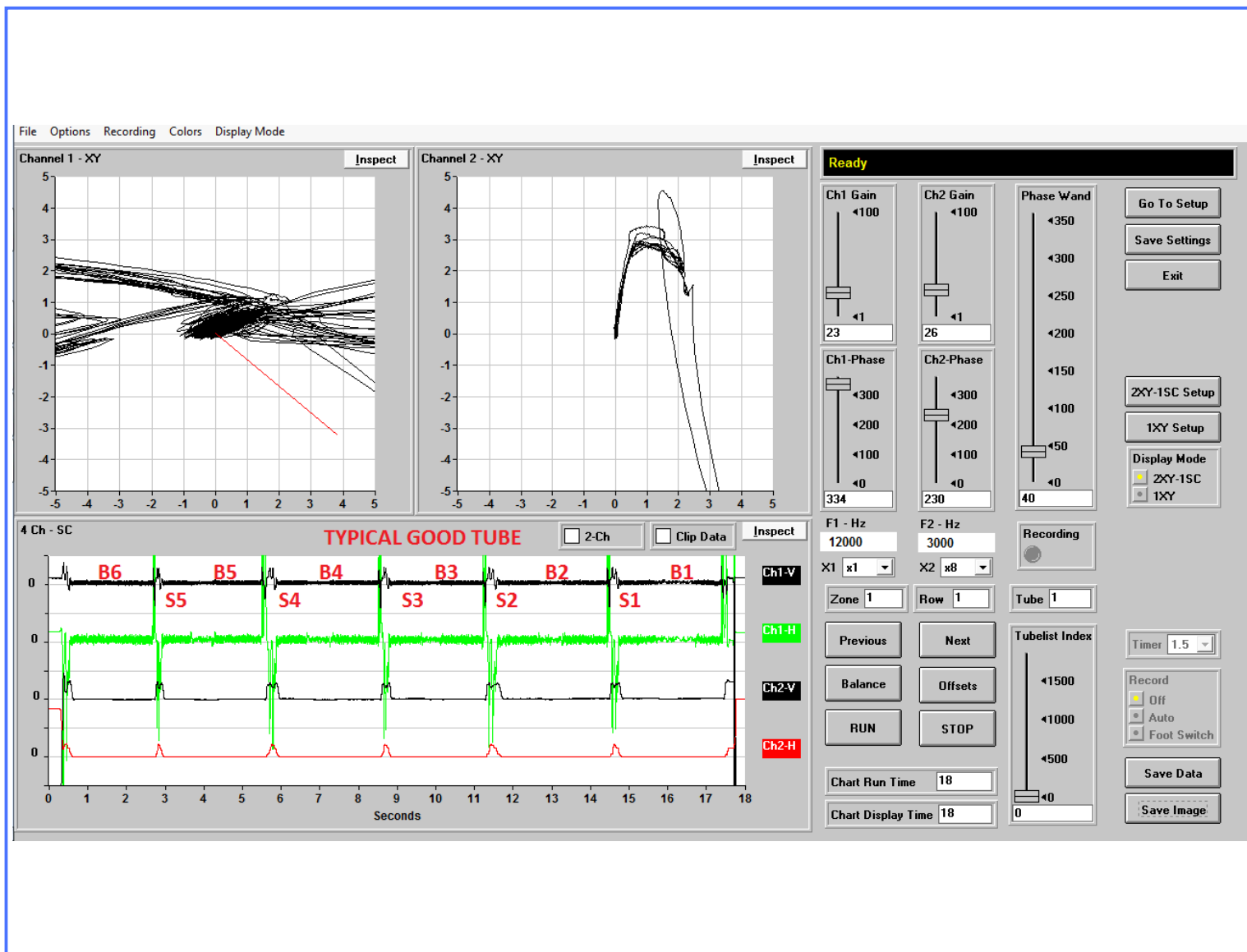
Tube Type	Material	Nom Wall Thick	End Wall Thick	OD	Test Type	Probe Diameter
Skip Fin IE	Copper	.028	.052	.750	CROSS/DIFF	.500

Evaporator



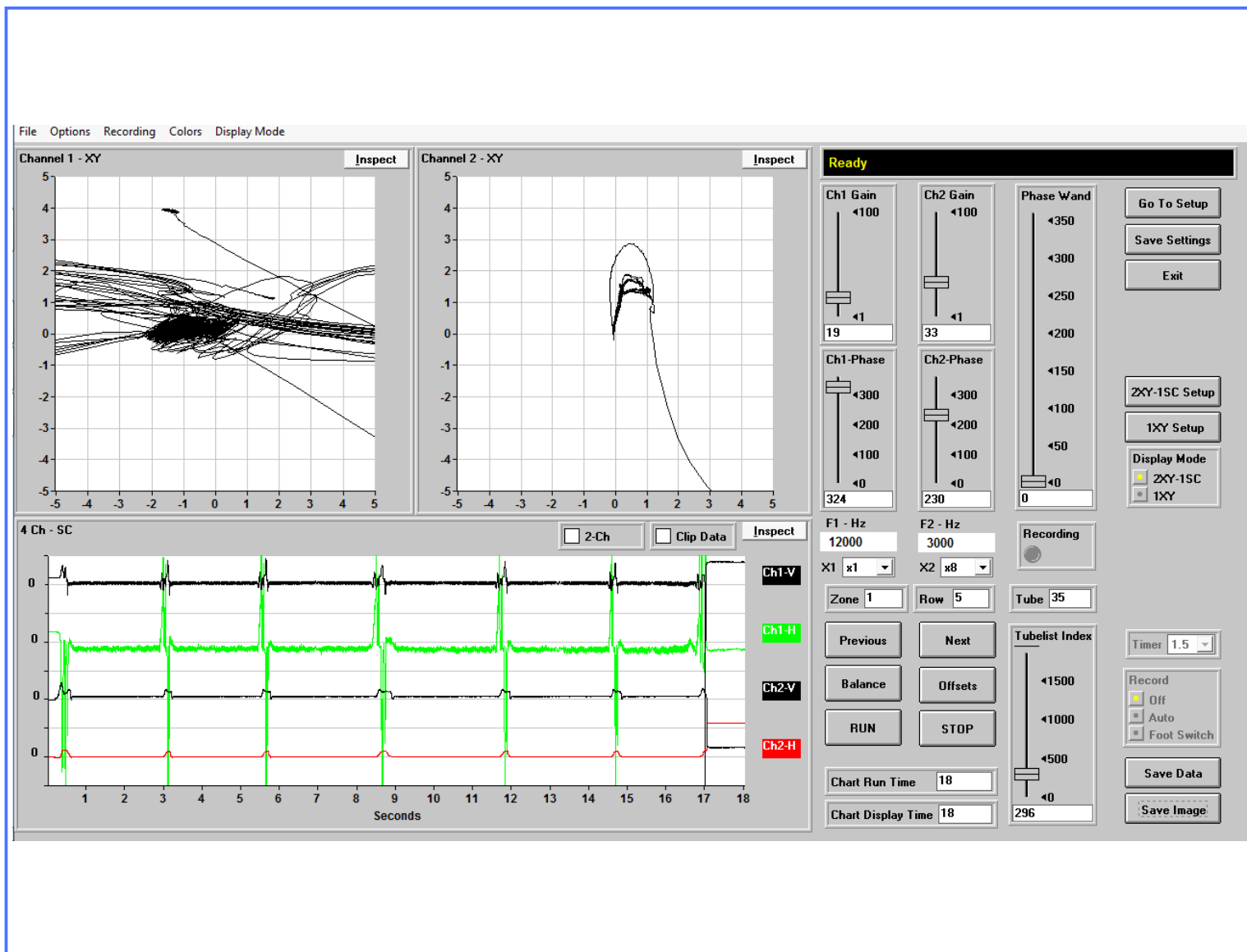
Note: Defects are compared to machined standards.  
Actual Defect Geometry may differ.

# Evaporator Section



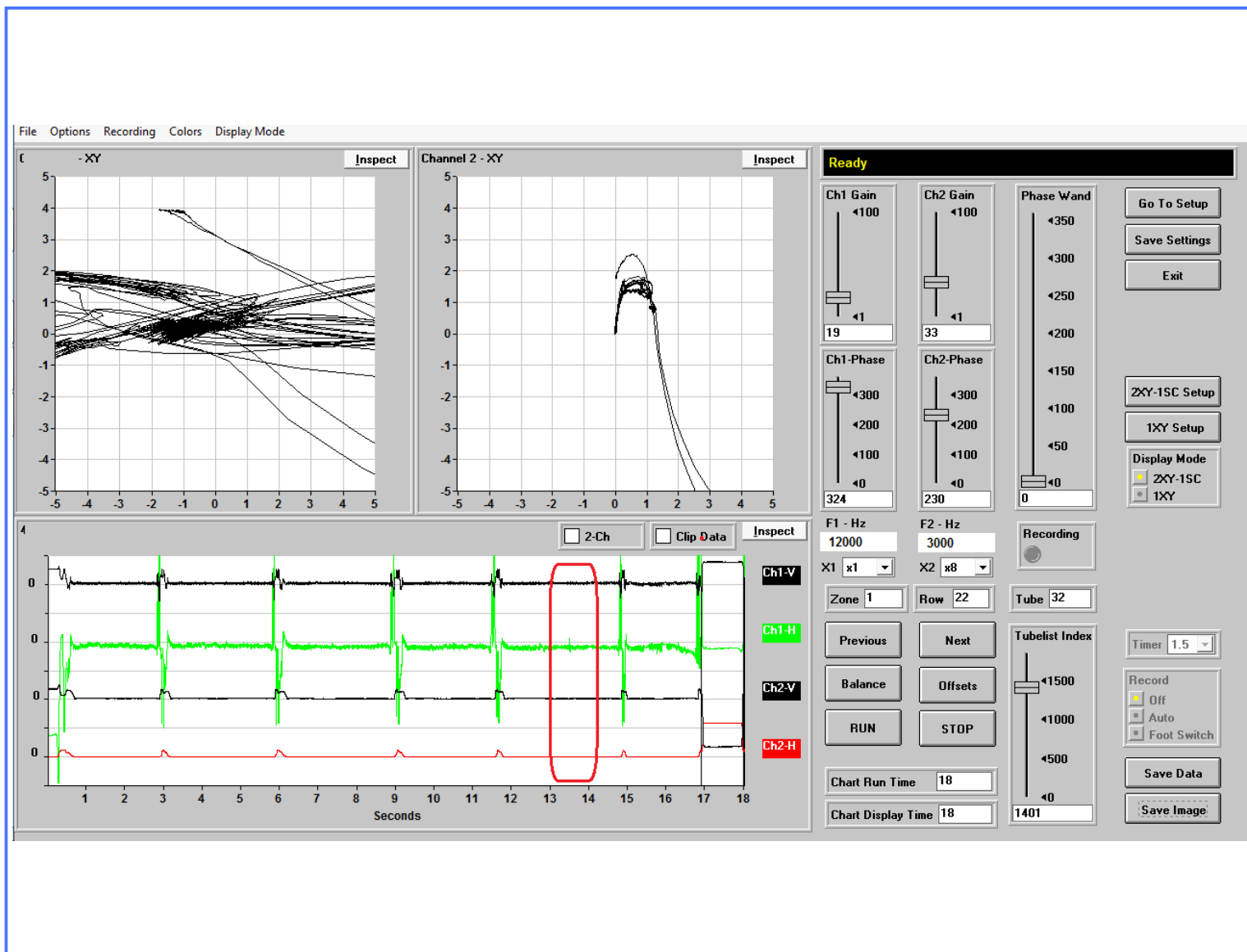
NO SIGNIFICANT DEFECTS (Row 1 Tube 1)

# Evaporator Section



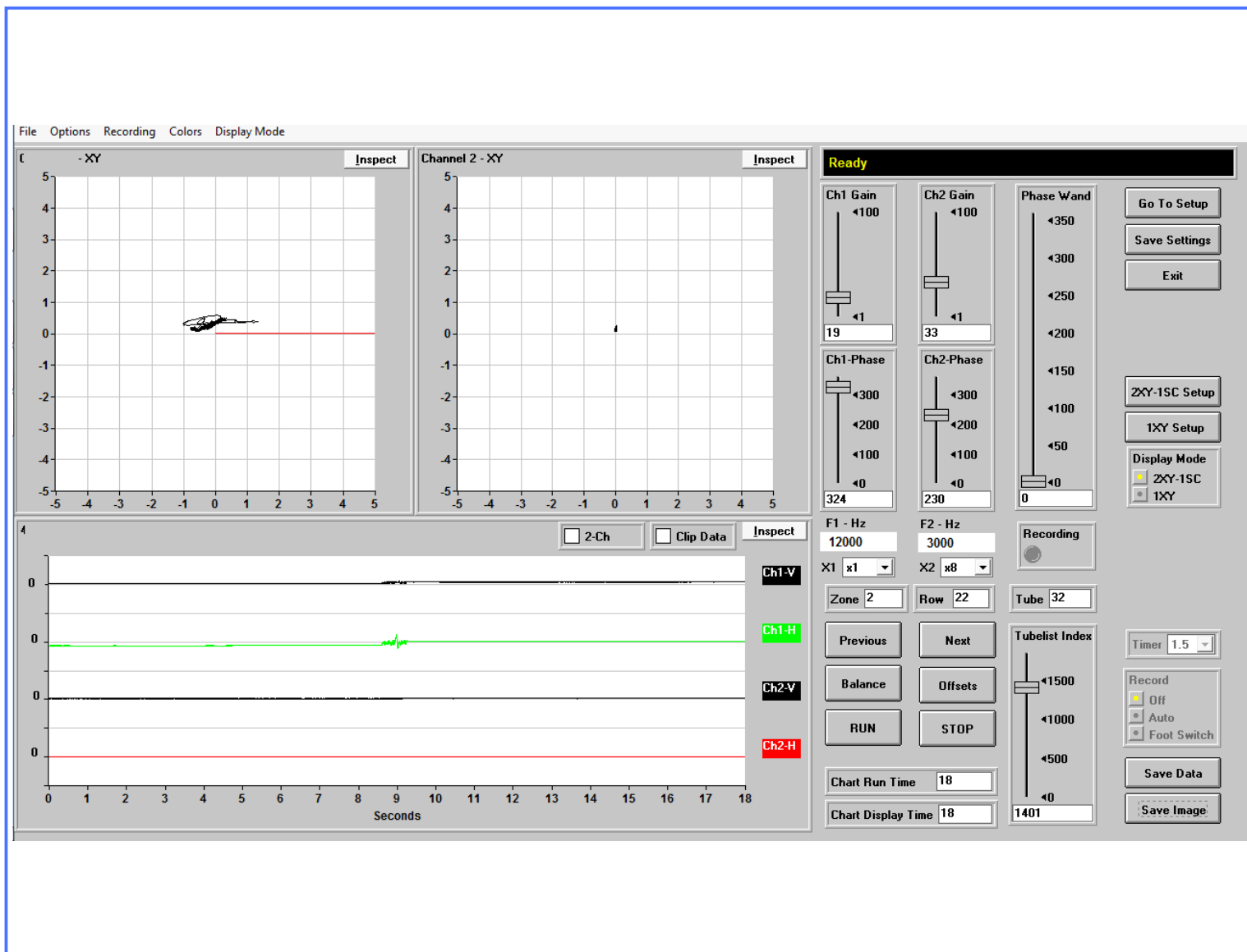
NO SIGNIFICANT DEFECTS (Row 5 Tube 35)

# Evaporator Section



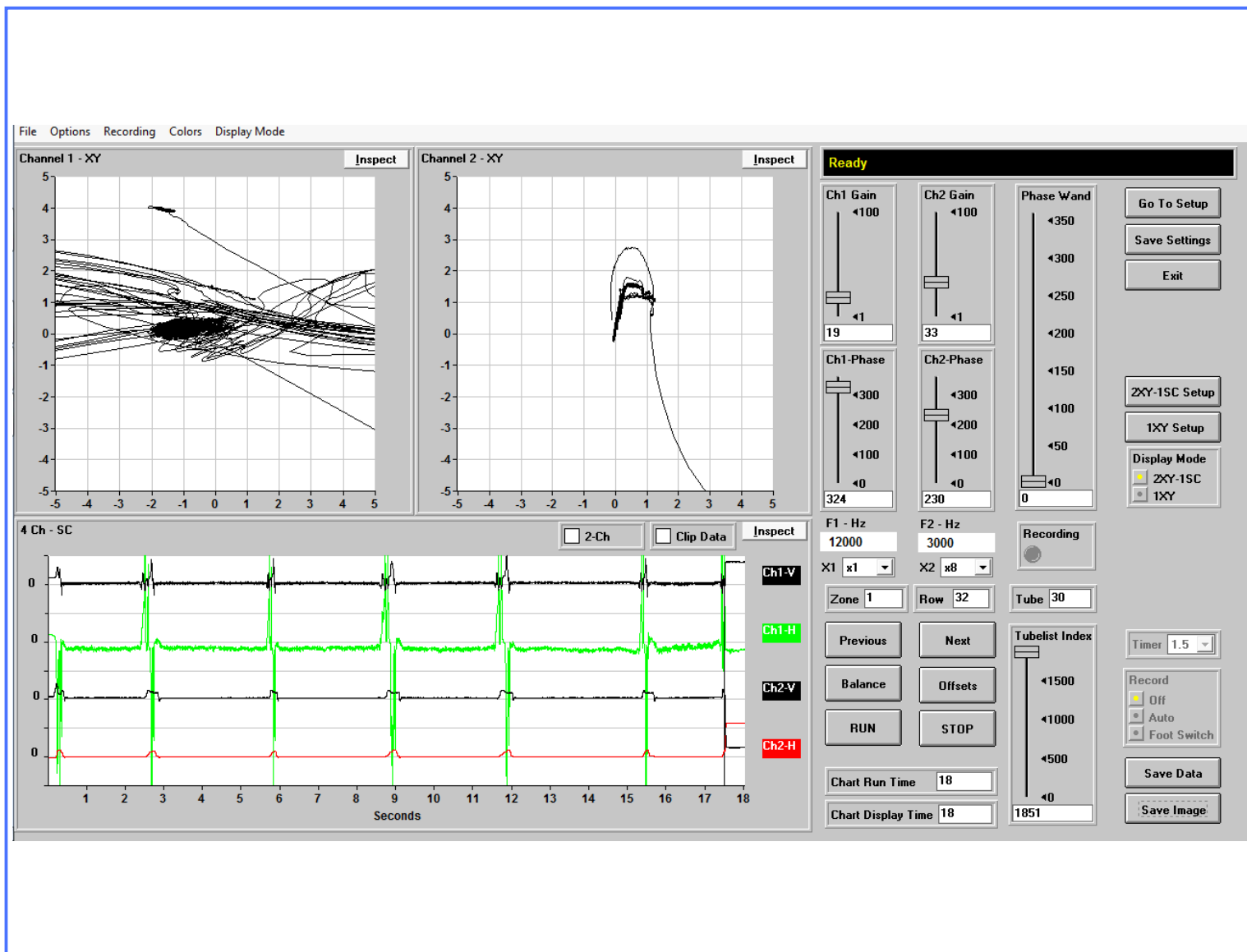
ID PIT < 20% (Row 22 Tube 32)

# Evaporator Section



ID PIT < 20% (Row 22 Tube 32)

# Evaporator Section



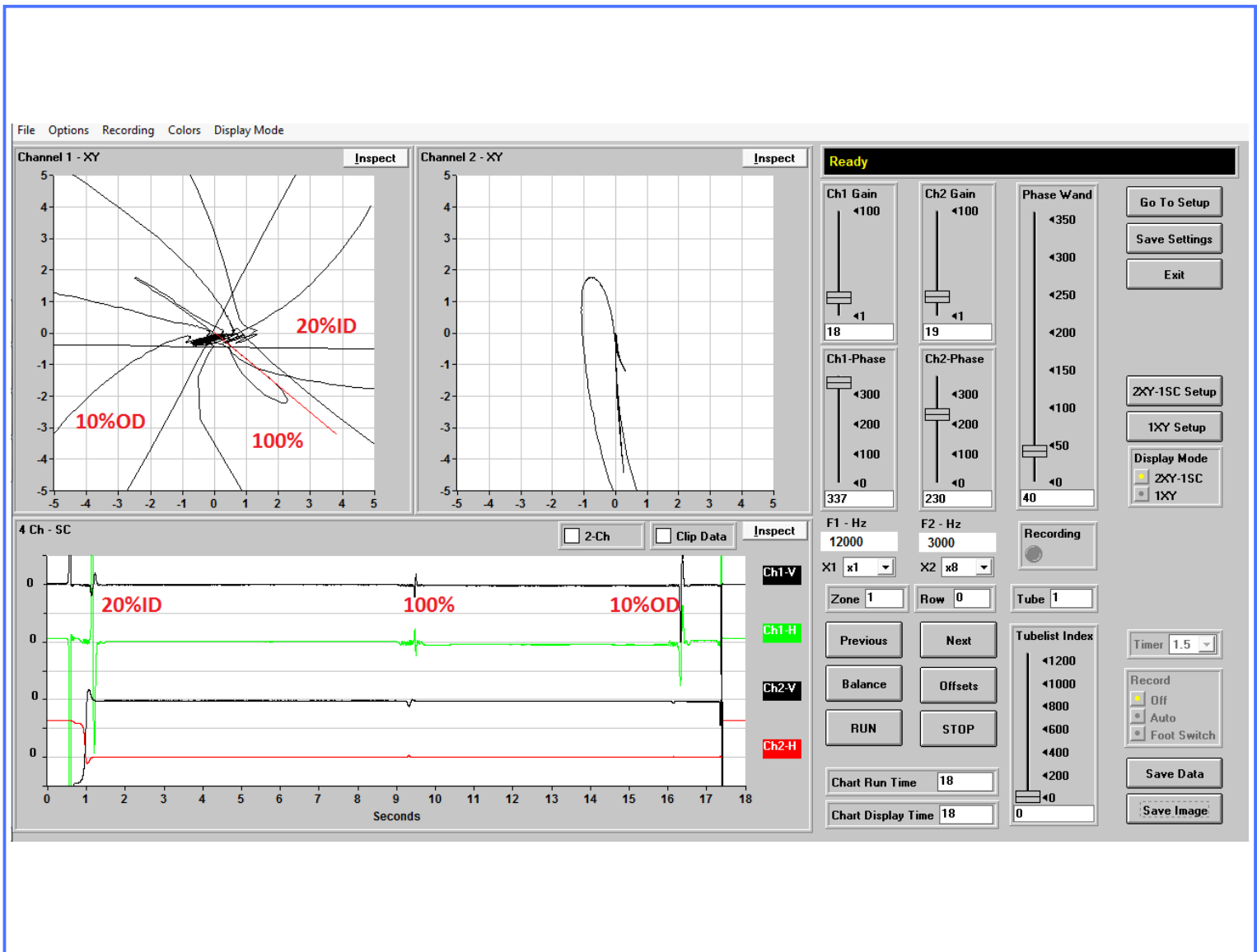
NO SIGNIFICANT DEFECTS (Row 32 Tube 30)

## Calibration Page

Tube Type	Material	Nom Wall Thick	End Wall Thick	OD	Test Type	Probe Diameter
Skip Fin IE	Copper	.028	.052	.750	CROSS/DIFF	.500

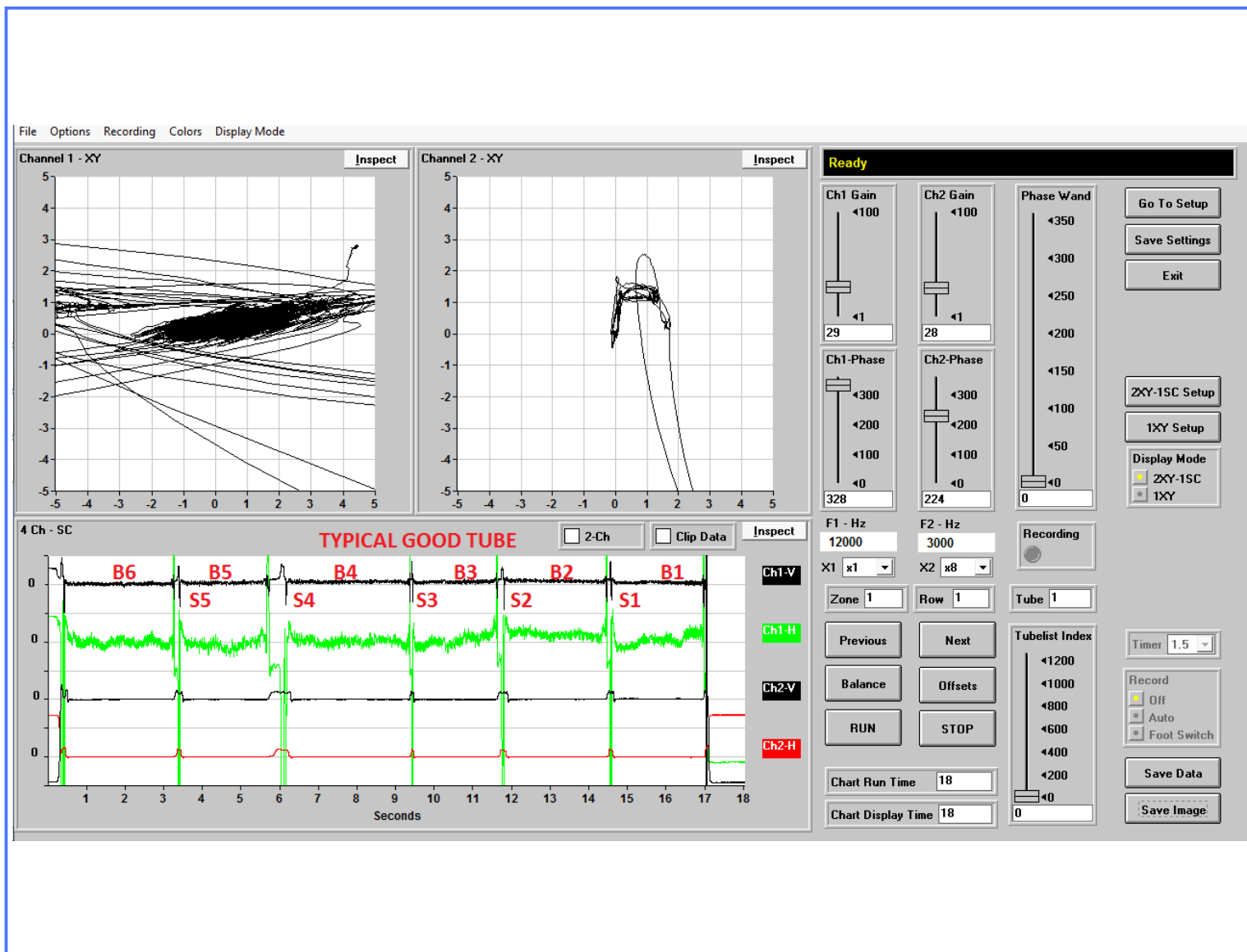
T/H Condenser

B/H Condenser



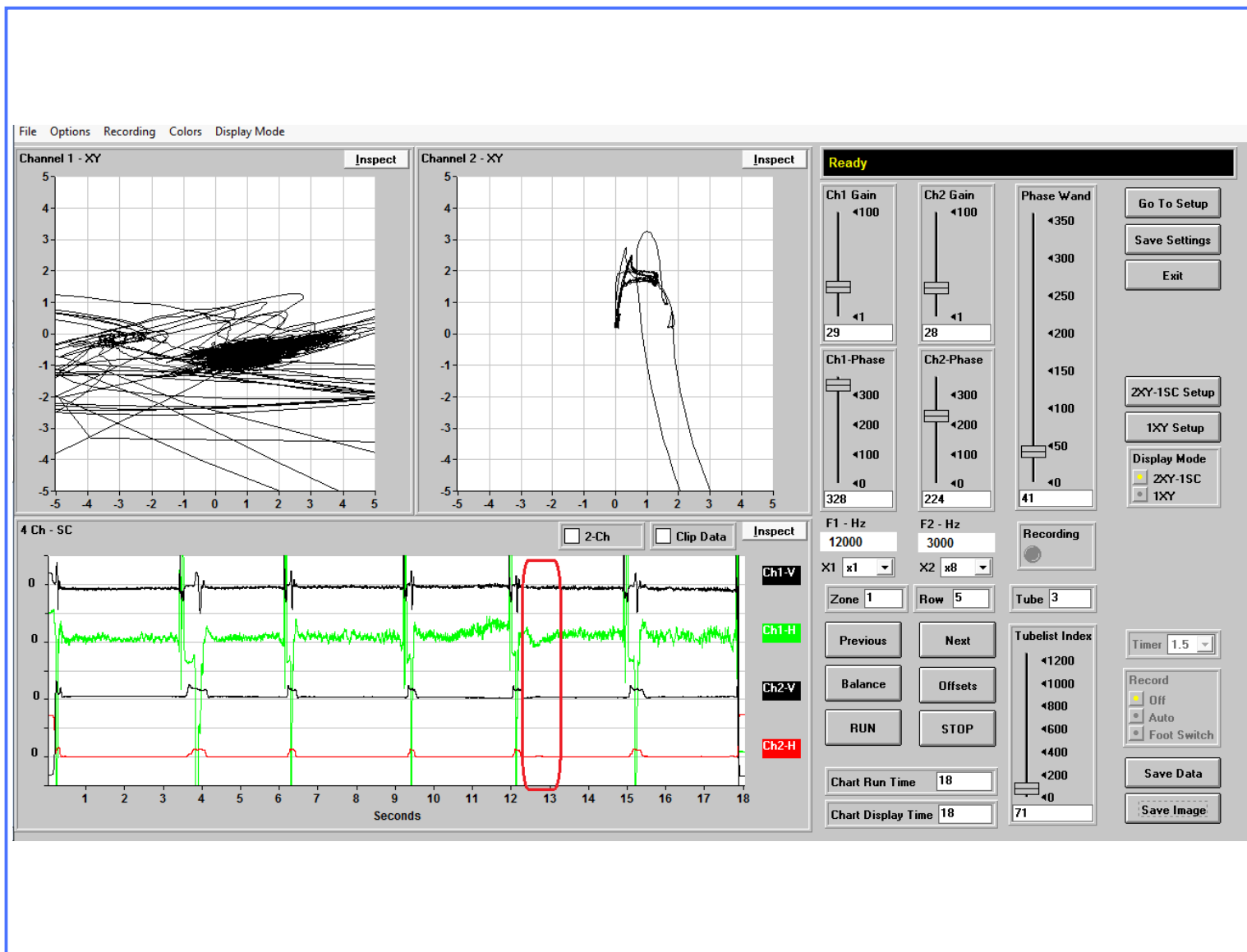
Note: Defects are compared to machined standards.  
Actual Defect Geometry may differ.

# T/H Condenser Section



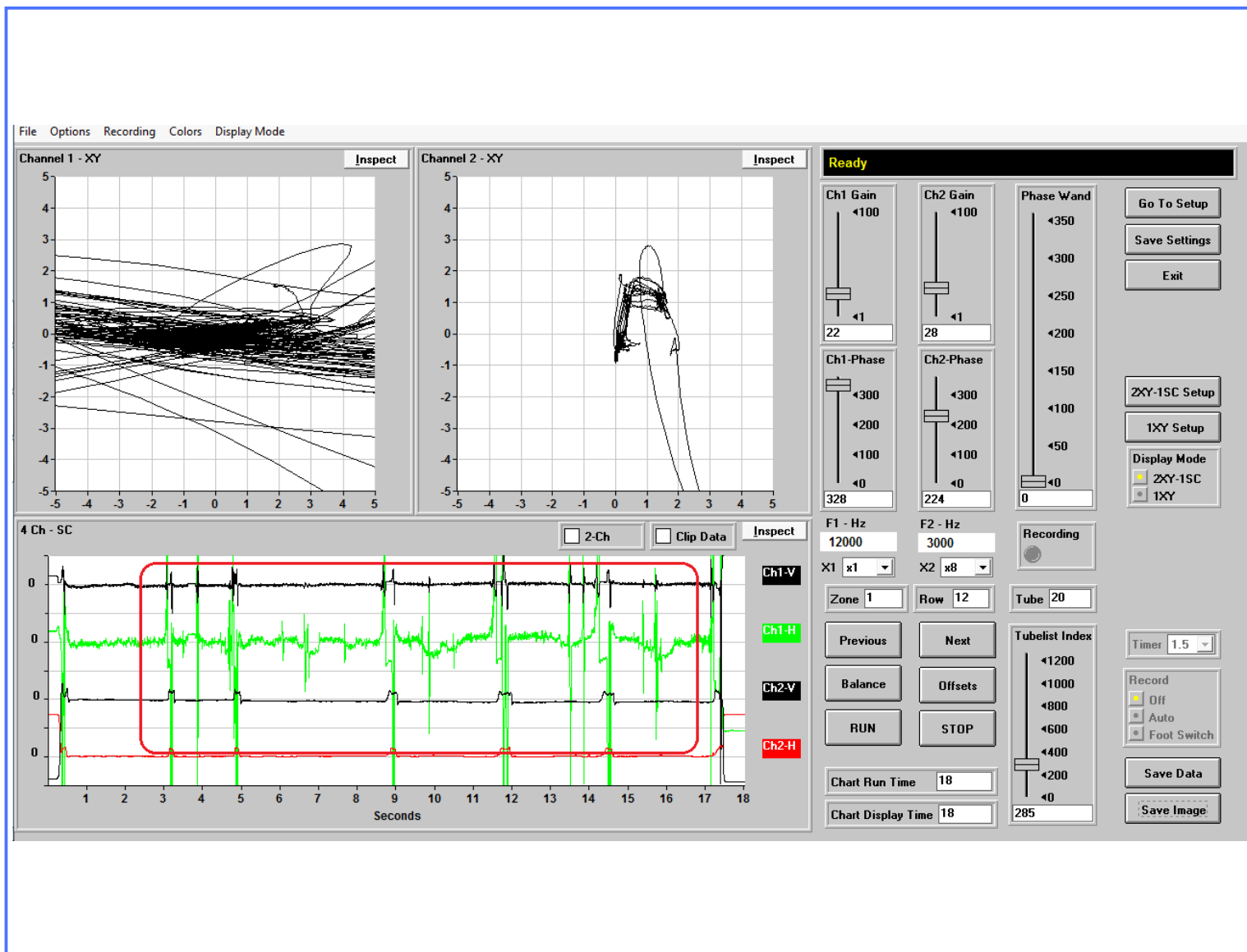
NO SIGNIFICANT DEFECTS (Row 1 Tube 1)

# T/H Condenser Section



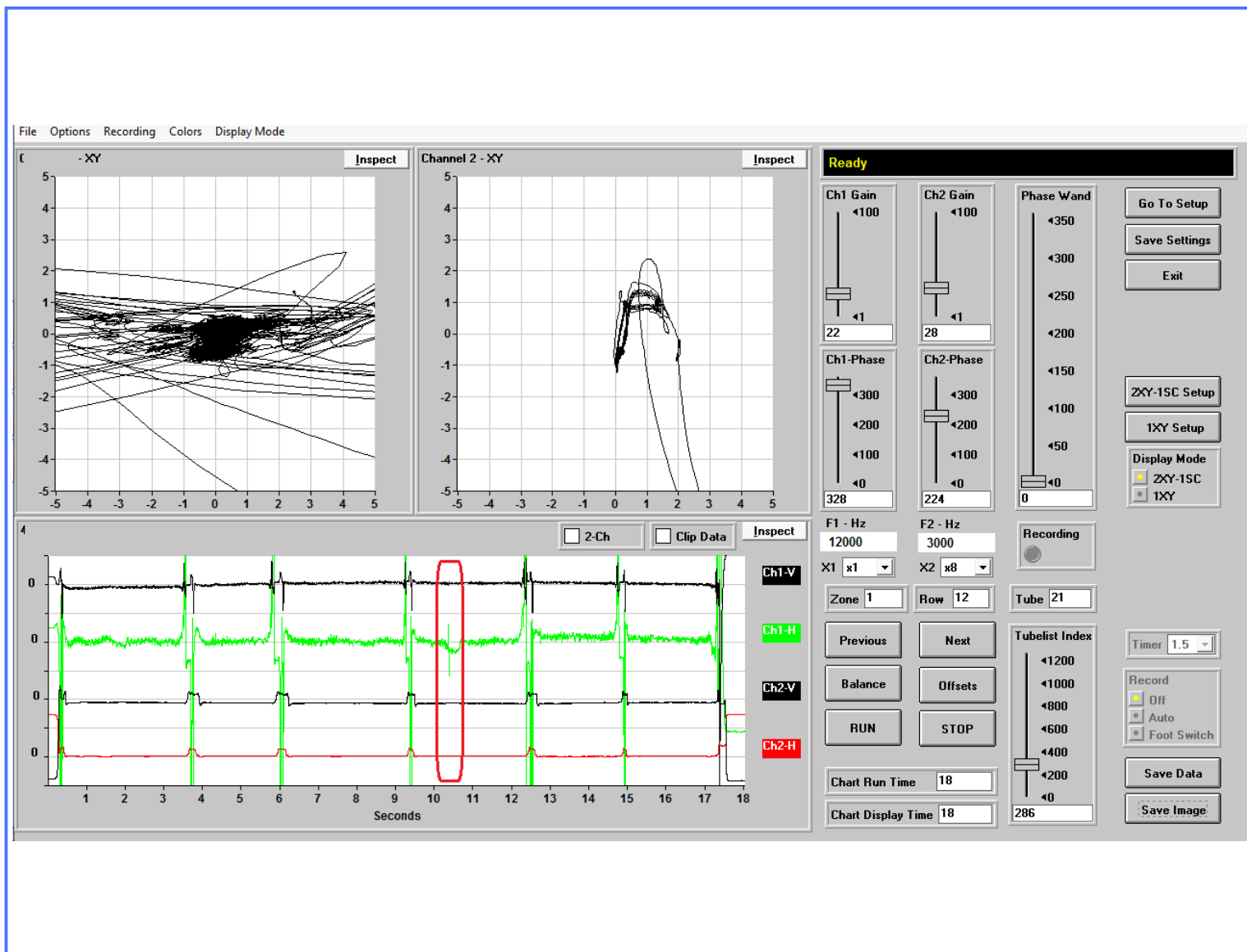
ID CORROSION < 20% (Row 5 Tube 3)

# T/H Condenser Section



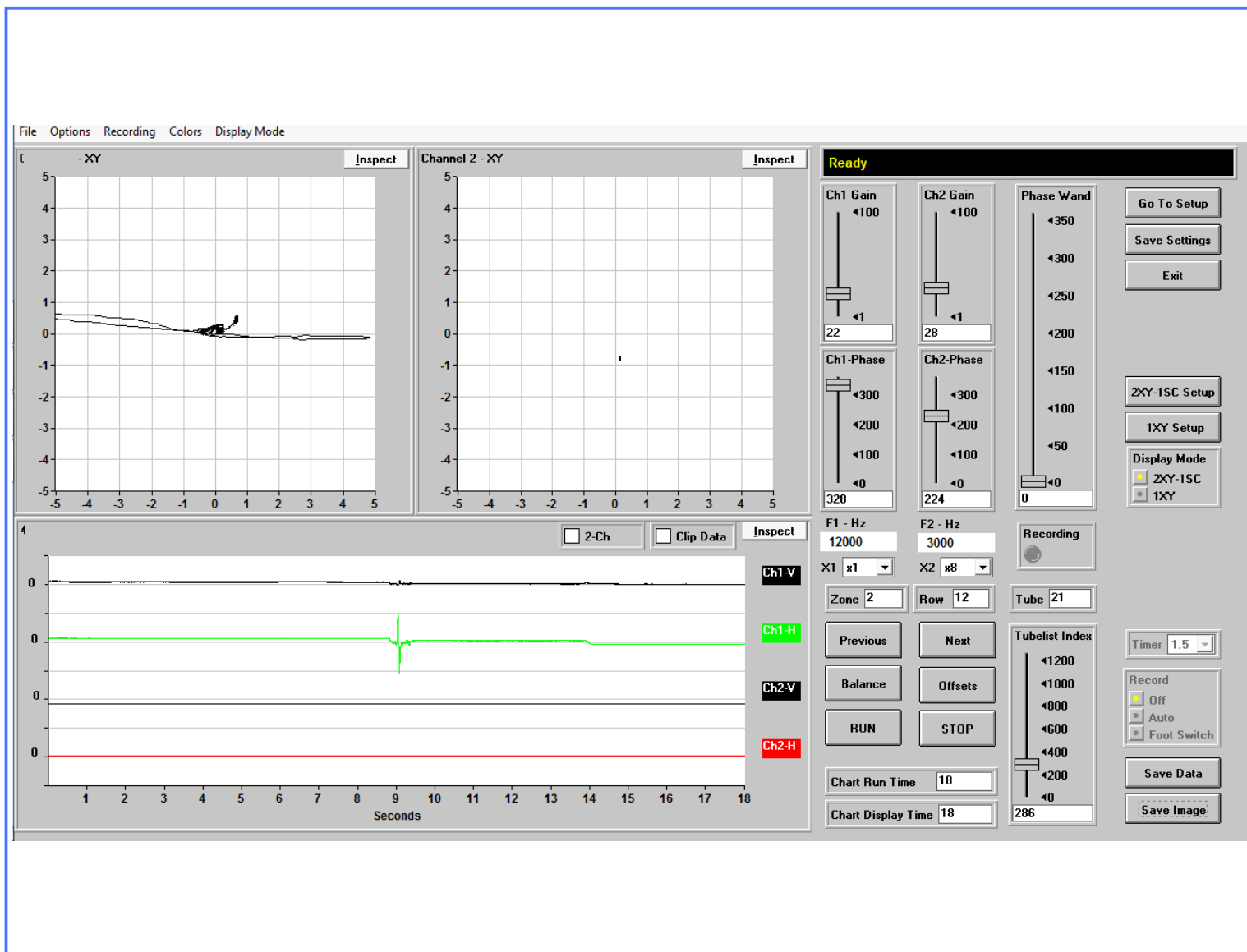
TESTED, DEBRIS (Row 12 Tube 20)

# T/H Condenser Section



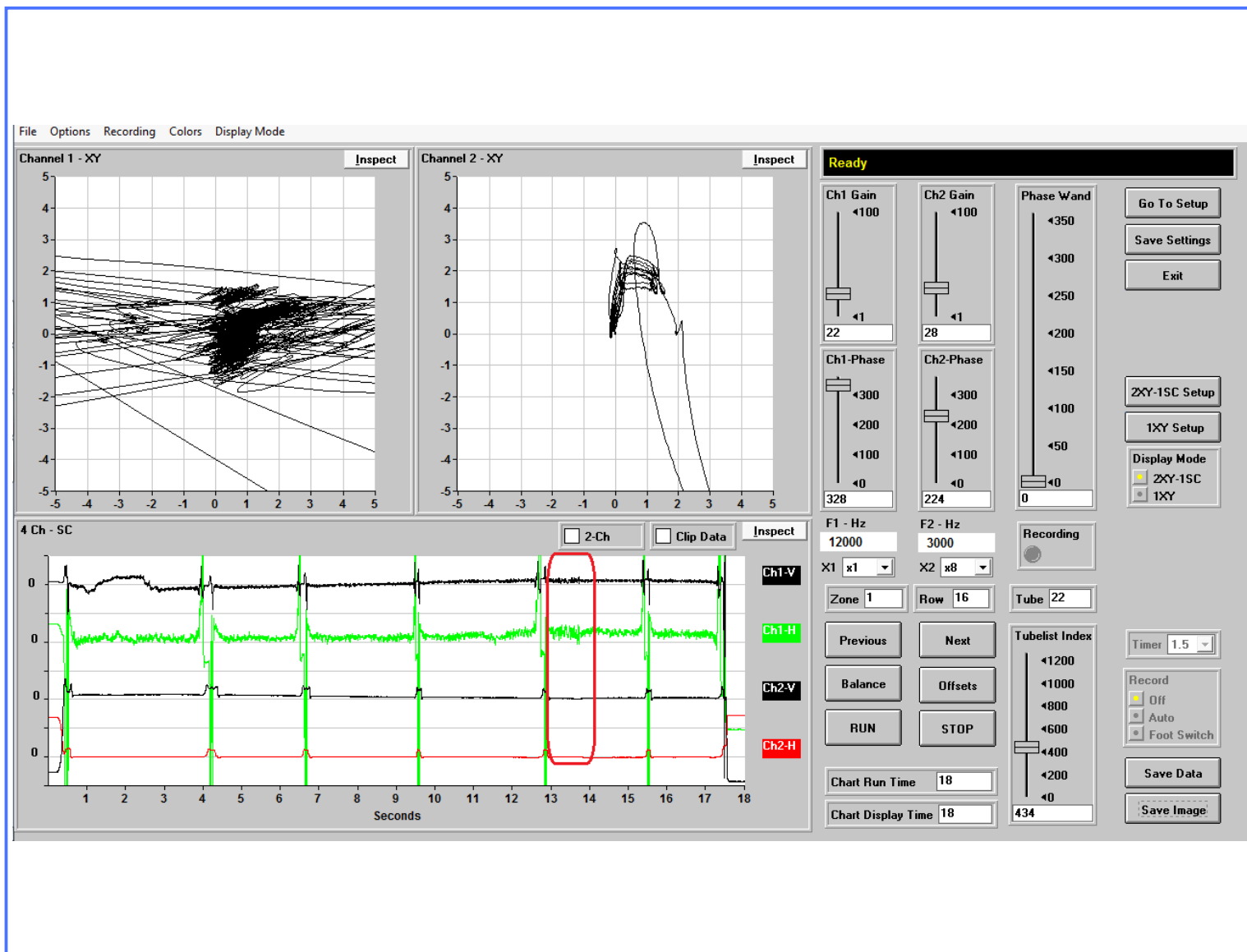
ID PIT < 20% (Row 12 Tube 21)

# T/H Condenser Section



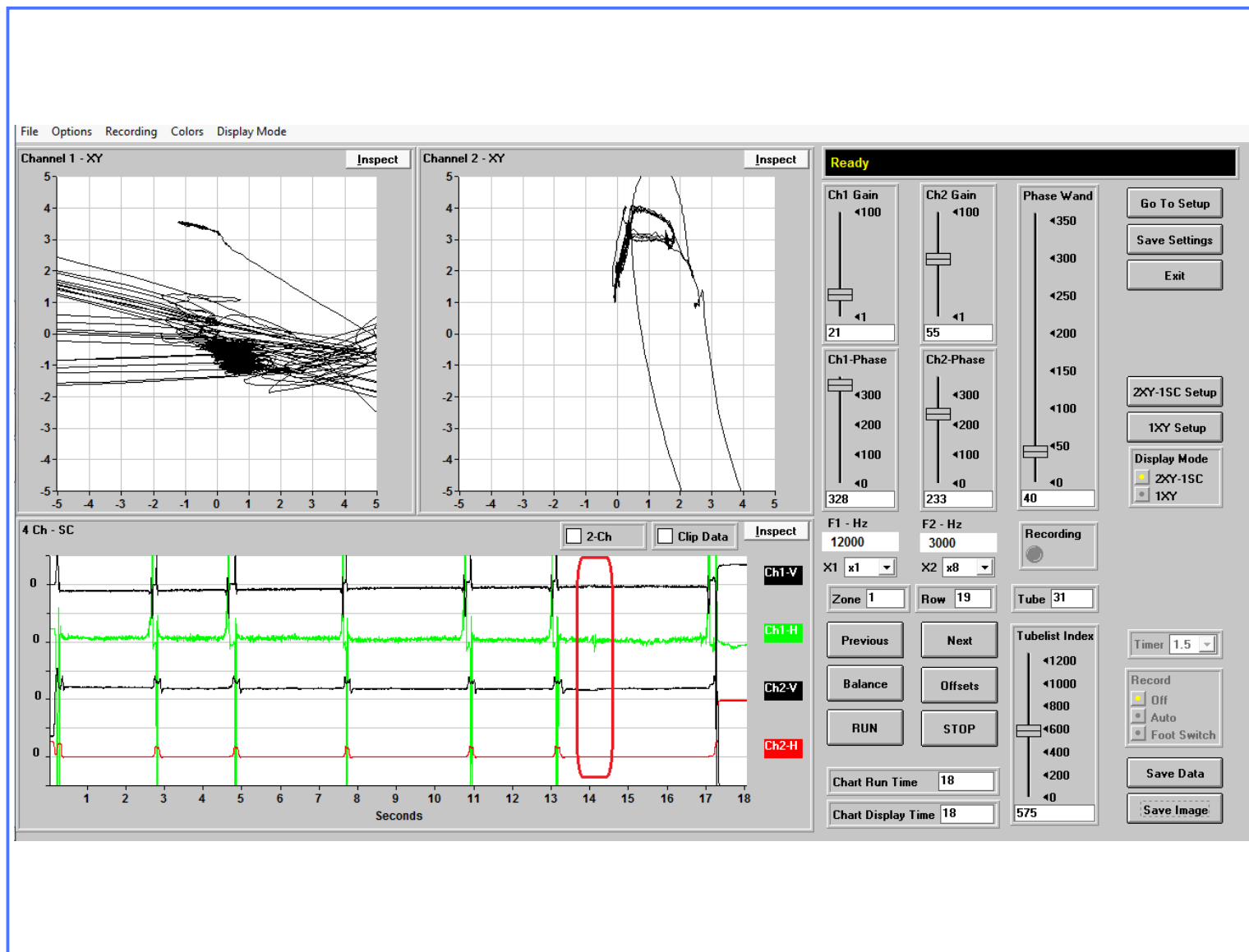
ID PIT < 20% (Row 12 Tube 21)

# T/H Condenser Section



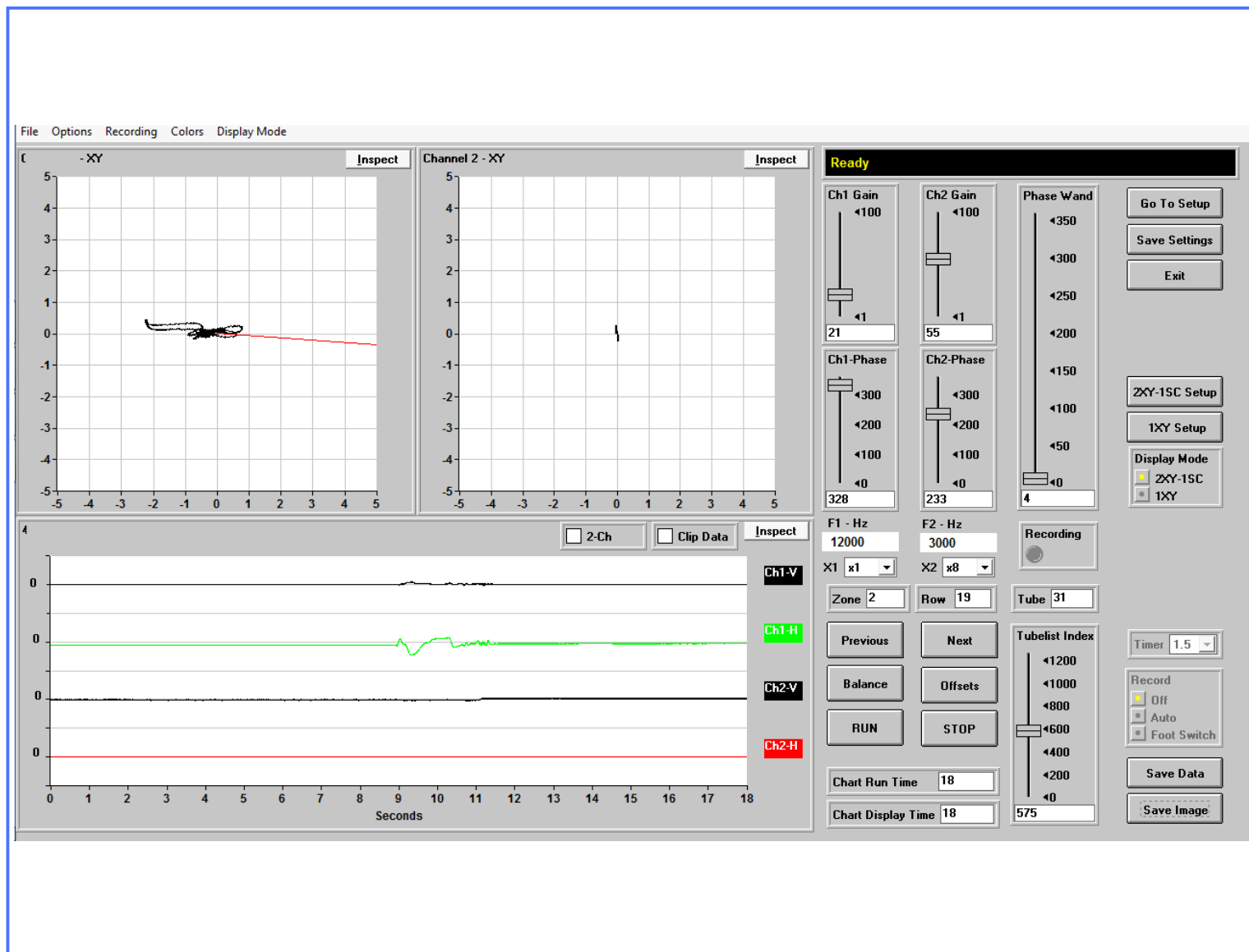
ID CORROSION < 20% (Row 16 Tube 22)

# T/H Condenser Section



ID PIT 20% - 39% (Row 19 Tube 31)

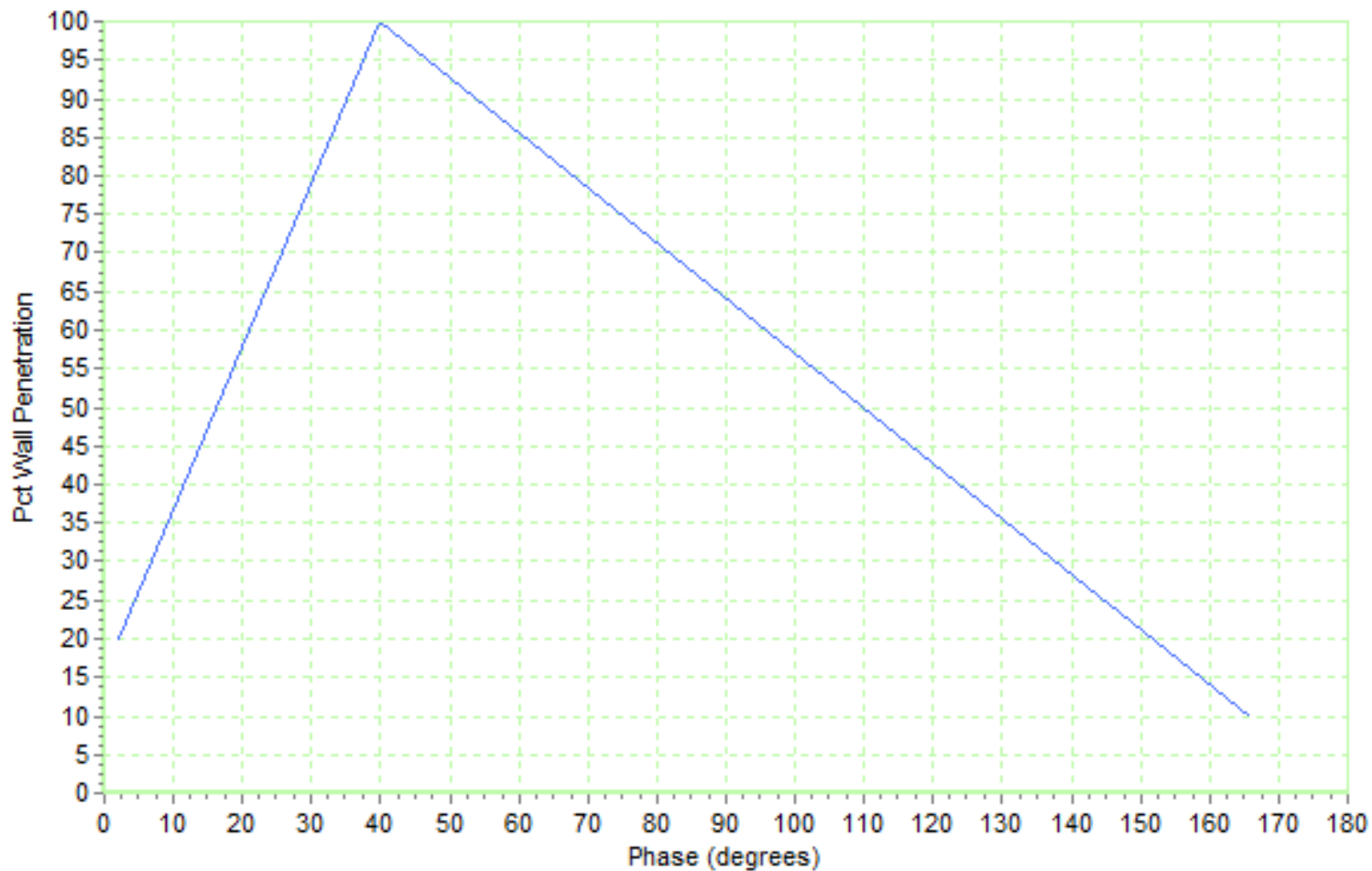
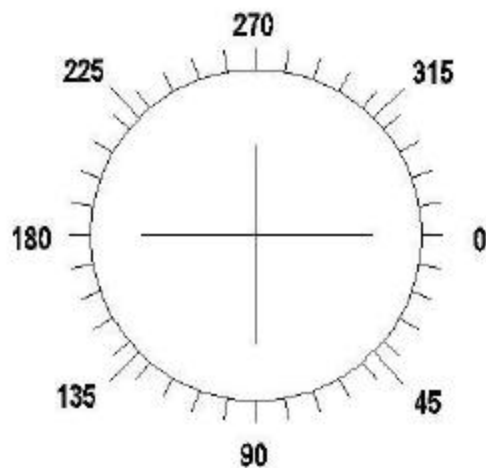
# T/H Condenser Section



ID PIT 20% - 39% (Row 19 Tube 31)

## Phase Chart - B/H Condenser

Material	Tube Type	OD	Wall	Test Type	Frequency	Probe Diameter
Copper	Skip Fin IE	.750	.052	CROSS/DIFF	12000/30	.500



## Calibration Procedure

A calibration procedure is performed prior to an inspection, and is repeated every 2 hours, or whenever improper operation of the test instrument is suspected. Test frequencies are selected prior to an inspection through experimentation to achieve optimum phase separation, and amplitude response for the tube type and alloy being inspected. An appropriate inspection probe is selected based on tube type, wall thickness, and alloy. The inspection probe will have a minimum fill factor of 80% through the smallest areas of the tubes being inspected. Instrument sensitivity is set high enough to determine background noise inherent in the tube and to produce a .05 Volt deflection for a .031 through wall hole at .25 V/Div.

## Calibration Reference Standard

A Calibration Reference Standard representing a typical production run tube of the same alloy, tube type and nominal wall thickness is used to adjust test system response. The calibration reference standard used for the inspection of finned and internally enhanced tubing, has been milled in accordance with the American Society for Testing and Materials (ASTM). Standard Recommended Practices, E-243-80, E-426-76, and E571-76. The depth of the grooves and notches used for establishing instrument response are calculated to compensate for the influence of the fins and/or internal enhancements used on finned tubes. Where applicable, calibration reference standards are milled in accordance with the American Society of Mechanical Engineers (ASME), Section V, Article 8, Appendix I.

A strip chart recording of each calibration reference standard used for the inspection has been included in this report. Each artificial discontinuity has been identified on the strip chart recording.

## Explanation of Abbreviations

Abbreviation	Explanation
ABN IND	Abnormal Indication
B	Bay
FB	Freeze Bulge
FBH	Flat Bottom Hole
FM	Foreign Material
ID	Internal Diameter
ID CORROSION	Internal Diameter, Corrosion
ID DEPOSIT	Internal Diameter, Deposit
ID PIT	Internal Diameter, Pit
IDML	Internal Diameter, Metal Loss
IE	Internally Enhanced
OD	Outside Diameter
ODML	Outside Diameter, Metal Loss
ODML@S	Outside Diameter Metal Loss at Support
OD DEPOSIT	Outside Diameter, Deposit
PLF	Possible Longitudinal Flaw
PRF	Possible Radial Flaw
PSC	Possible Stress Corrosion
S	Support
WAS	Wear at Support
>	Greater Than
<	Less Than
OTE	Opposite Test End
TE	Test End